THE

ELECTRICAL REVIEW.

VOL. LIII. DECEMBER 18, 1903. No. 1,360.

"ELECTRICAL REVIEW."

Vol. LIII] CONTENTS: December 18, 1903. [No. 1,360.

	Page
William Gilbert, of Colchester	973
Telephony in Glasgow	974
Central Station Economies: The Utilisation of Condensed Steam (*illus.*)	976
Protection in Relation to Tramway Enterprise	976
Legal	977
Correspondence	979
Business Notes	985
Recent Extensions of the Bradford Corporation Electrical Undertakings (*illus.*)	991
Durban (S. Africa) Electric Light and Tramways (*illus.*) (*concluded*)	994
Electricity Supply Accounts	999
City Notes	999
Stocks and Shares	1002
Share List of Electrical Companies	1003
Market Quotations	1004
Electric Tramway and Railway Traffic Returns	1004
The British Association:—	
The Resistance of Road Vehicles to Traction (*concluded*)	1005
Institution of Electrical Engineers:—	
Proceedings of December 10th	1005
The Slow Registration of Rapid Phenomena by Strobographic Methods (*illustrated*)	1006
Dublin Local Section	1007
The Cruse Controllable Superheater (*illus.*)	1007
Physical Society	1008
Notes on Engine Driving in Electric Light Stations (*concluded*)	1008
Annual Dinner of the I.E.E.	1009
On Some Fictitious Figures Supplied by Municipal Engineers	1010
The St. Marylebone Borough Council	1011
New Patents Applied For	1011
Published Specifications	1012

THE

UNIVERSAL ELECTRICAL DIRECTORY

1903 Edition

Price 10s. Post Free.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone No. 988 Holborn.

All Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street, Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

WILLIAM GILBERT, OF COLCHESTER.

IT is but a few months since the Institution of Electrical Engineers did homage at the tomb of the great Alessandro Volta, in Italy; last week, on December 10th, the Institution commemorated the 300th anniversary of the death of one who preceded Volta by two centuries—William Gilbert, the father of electric science, who was born in Colchester in 1544, and died there in 1603.

The son of well-to-do parents, William Gilbert received a liberal education. He graduated as Doctor of Medicine at Cambridge in 1569, and travelled on the Continent for three years. Afterwards he settled in London, and quickly acquired a high standing in his profession, becoming President of the Royal College of Physicians in 1599, and physician to Queen Elizabeth in 1601. A man of marked independence of thought, Gilbert scorned empirical methods and ideas, and rested his faith on experimental observations and inductive reasoning, anticipating by many years Francis Bacon, who is so commonly regarded as the founder of experimental science.

Apart from his medical accomplishments, the life work of Dr. Gilbert was the study of the science of magnetism. In his day innumerable superstitions and idle fancies were associated with the loadstone; these he combated with vigour. But far more important were his original discoveries relating to the properties of magnets in general, which were embodied in his famous work, "De Magnete," published in 1600. Having regard to the times in which he lived, and to the ideas then prevalent, this work must be admitted to be one of the most remarkable productions of human labour and intelligence in existence. Most great works of this kind have been the fruit of many minds; but Gilbert wrought alone. To him we are indebted for the discovery of the essential feature of the closed magnetic circuit; for he first fitted pole-pieces to the polar faces of a loadstone, and thereby increased its lifting power 80 times. It was Gilbert who made the pregnant discovery that iron could be magnetised by hammering it while it lay north and south; that a sheet of iron had a screening effect on magnetism; that magnetism was destroyed by heat; that a magnet possessed a magnetic field. His observations on the phenomena of terrestrial magnetism, and on the behaviour of loadstones and compass needles towards each other, were innumerable. Above all, he made a model globe of loadstone, and studied its effects on small compass needles at various parts of its surface, whence he deduced the (at that time) astounding theory that the earth itself was a gigantic magnet! Needless to say, opposition was not wanting to his views; but nevertheless, in spite of this, his book became the standard work on magnetism, and held its place for 100 years. What may appear still more remarkable, is the fact that he was honoured by his immediate contemporaries such as Galileo and Kepler.

But Gilbert did not confine his researches to magnetism; he discussed at considerable length the resemblance between the attractions due respectively to magnetism and to static electricity, and showed that not only amber but many other substances also were capable of electrical excitation, including the classic glass rod and stick of sealing wax. Moreover, he observed that these phenomena were most readily exhibited in certain states of the atmosphere, and that all known substances were amenable to the attraction of the excited body. The invention of the electroscope was his. He observed the discharging power of a flame or hot air; the screening effect of paper or linen on electric attraction; the rectilinear action of the attraction; the drawbacks of hygroscopic materials in exhibiting electrical experiments, and many other interesting facts.

It must not be supposed that Gilbert made no mistakes; on the contrary, he fell into several notable errors. Nevertheless, his work constituted so great and original an advance beyond the knowledge then existing, that his title to the designation of "Father of Electric Science" cannot be disputed; neither can his claims to be regarded as the founder of experimental philosophy be set aside. To honour his memory is to honour ourselves. As Dryden sang—

> Gilbert shall live till loadstones cease to draw,
> Or British fleets the boundless ocean awe!

We cannot conclude this brief appreciation without expressing our indebtedness to Gilbert's biographer, Prof. S. P. Thompson, whose pleasure it has been to gather together the scanty records of his life, and to embody the fruits of his labours in pamphlets in a style worthy of the subject and the author.

TELEPHONY IN GLASGOW.

Municipal telephone committees are nothing if not amusing. The paragraph recently circulated apparently at the instigation of the Telephone Committee of the Glasgow Town Council reminds us irresistibly of a very old story of an Irishman who had a grievance against a countryman in a distant town. The hero of this story made a special journey to interview his critic, and, on his return, was relating to a friend the adventures of his enterprising journey. "Well, what did you say to him?" asked the friend. "I told him, sor, that I should treat him with silent contempt!"

The Glasgow Telephone Committee, we learn, has had before it articles "condemnatory of the telephone accounts" which have appeared in "certain electrical and engineering journals." The announcement goes on to say, in a ten-line sentence in which the auditors, the sub-committee on finance, the Telephone Committee and the Town Council stand shoulder to shoulder against all comers, that the accounts call for no defence against articles written "in such obvious ignorance of the conditions which prevail in Glasgow, and with such apparent bias and purpose." Perhaps the proximity of Belfast to Glasgow is responsible for this interesting announcement that all criticisms are to be treated "with silent contempt"; but one cannot help thinking that, having come to the decision, it would have been more dignified—and convincing—to be silent about the decision also. To shout vociferously that you are going to say nothing is apt to create the impression that you have nothing to say.

Our very sincere sympathy is extended to the Glasgow Telephone Committee and to the eminent and independent firm of auditors in the awkward situation in which they have been placed by people and circumstances over which they have no control. It is not the fault either of the members of the Committee or of the auditors that they know little of the telephone business, and find themselves engaged in the ungrateful task of trying to make water run uphill. We trust that we and others of the "electrical and engineering journals" have enlightened them a little on the peculiarities of business telephony on a large scale—still a comparatively unknown country to them—and, in spite of our "obvious ignorance of the conditions which prevail in Glasgow," we shall endeavour in the future to enlighten them, and others, still more.

Fortunately, our vocation is not such that it is either to our interest, or to that of our readers, to treat with silent contempt any subject in which we or they are interested, and Glasgow is luckily not so remote from London as to preclude all hope of improving our knowledge of the telephonic conditions which prevail there. We confess to a certain suspicion that the ignorance displayed in our previous articles on the subject is not quite so "obvious" as the Telephone Committee would wish its friends to believe. In any case, we shall endeavour constantly to add to our stock of information on the subject, and shall hope at no distant date to lay the result of our further studies before our readers and the Glasgow Telephone Committee. We are not without hope that at some time or other even the Committee itself may awaken to the real facts of the Glasgow Corporation's telephone venture. When that happens the back numbers of the Review will be of more value to its members, as a work of reference, than even the 35 volumes of the "Encyclopædia Britannica."

Compulsory Life-guards in Paris.

It appears that the Parisian multi-system tramways have gained such a heavy record of fatalities and injuries by reason of the absence of efficient life-guards, that the Prefect of Police (M. Lépine), acting on the recommendation of the Chief Inspector of Tramways, a short time ago decided to advise the operating companies, first, that the number of serious accidents demonstrated the inefficacy of the existing guards; secondly, that each company was to seek out the life-guard best suited to its rolling stock while complying with the usual requirements for safety, and to forward, not later than October 1st, the designs of the proposed guards for the approval of the Prefect; and, last, that the installation of such life-guards as would satisfy the imposed conditions, should be made obligatory before January 1st, 1904, on the cars of companies not sending in proposals.

The companies obeying the Prefect's behest had to state the time that the installation of the guards would occupy, and it was, of course, compulsory for the companies to fit the approved guard.

The Union des Tramways de France forwards the complete text to the Tramways and Light Railways Association with the statement that it has recently been collecting evidence to show that nothing more complicated than the fixed fender of wood placed across the wheels near the track and attached to the axle-boxes, is needed to safeguard the public.

It is interesting to observe that the Prefect of Police stipulated expressly that the new guards must not project beyond the platform, thus putting out of court the type of

guard so largely adopted in the States, and to some extent on the Continent. Here the Prefect is in accord with our own Board of Trade, and with the majority of tramway men in this country.

Contained in the same number of the Association Circular are notes by foreign and English experts questioning the necessity for complicated automatic apparatus. In Munich, for instance, the cars are fitted with a guard that seems to meet with the approval of M. Lépine, but in 1902 there were six cases of serious injuries and four deaths due to persons being crushed under the front part of cars, a record that compares badly with, say, the Liverpool record for 1902, where not even serious injury occurred to anyone who fell under the platform of cars guarded by the "plough" fender, although there were four fatalities caused by the Peckham death-trap.

The English expert knows of no better type than the rigid plank, and suggests that the dangers of the brake spindle, which extends below the platform and forms a dangerous obstruction to persons falling under the platform, may be minimised by protecting it with a wire cage or a rounded wooden buffer. He ends with words which embody the view consistently taken by ourselves:—"Well trained, well-disciplined men, and perfect brakes, are the very best lifeguards a company can possess."

There was never a guard of any consequence on the old steam cars, and anything like an efficient guard on electric cars is only a few years old, but the natural desire of tramway undertakers to avoid accidents on both humanitarian and monetary counts, added to the spur of public opinion, and the steady and increasing pressure of the B. of T., have all led to the fitting of some more or less reputable guard on almost every British car, and it is difficult to believe that a similar result might not have been obtained in Paris if the conditions had been natural, so avoiding the present instance of bureaucratic compulsion, which must ever be unhealthy for the State and irritating to the subject.

Death by Lightning.

The question whether, when a workman is killed by lightning during the course of his employment, his representatives can obtain compensation under the Act of 1897, recently came before Judge Bradbury at the Liverpool County Court. It appeared that on August 14th in the present year a bricklayer, whose death gave rise to the action, was at work with his mate on a scaffold. The scaffold was 23 ft. in height. At the first hearing a doubt arose whether the fact that the deceased was working on a scaffold 23 ft. from the ground made an appreciable increase in the risk of his employment, as compared with working on the ground, and his Honour adjourned the case for expert evidence to be called on that point. At a subsequent hearing Dr. C. C. Garrard, head of the testing department at Ferranti's works, and Mr. J. M. Faulkner, of Manchester, both gave evidence to the effect that the fact of his being on the scaffold had sensibly increased the risk. His Honour held that inasmuch as the position in which the deceased was working was a dangerous position, he found as a fact that the accident arose out of, and in the course of, the employment. He therefore gave judgment for the plaintiff, but expressed the wish that the matter might be taken to the High Court for final adjudication.

This is one of the nicest questions in connection with the Workmen's Compensation Acts which has yet arisen. As our readers are well aware, compensation is payable where the accident arises "out of, and in the course of, employment." That the death by lightning was caused "in the course of" the employment, there can be no doubt, but how can it be said to have arisen "out of" the employment in the strict sense of the term? The Act is intended to insure workmen against any accident which is the result of any risk to which they may be exposed in the course of the particular employment. Thus if a brick were to fall on a bricklayer's head, or if he were to fall from the scaffold, his employers would clearly be liable. But everyone who is exposed to the weather during a thunderstorm is liable to injury by lightning. How, therefore, can it be said that this particular accident arose out of the employment? It must be assumed that, in coming to his conclusion, the learned judge was influenced by the opinion of the witnesses, who stated that the fact of the deceased being on a scaffold 23 ft. high exposed him to a somewhat greater risk. We shall await with interest the review of this decision in a higher Court, although it is quite possible that the judges may say that the question was one of fact for the County Court Judge.

Municipal Telephone Competition.

The *Times* of the 14th inst. publishes correspondence between the Postmaster-General and the Town Clerk of Brighton on the subject of free service to the municipal exchange, and certain offers of money which were made by the chairman of the Telephone Committee to residents at Burgess Hill, details of which were given in our last week's issue. The Postmaster-General recognises that some interval must elapse between the connection of the first subscriber and the opening of the exchange service, for which subscribers pay subscriptions, but he clearly is of opinion that the Brighton Corporation intends going beyond what may be considered reasonable. He regards the arrangements made as a breach of Clause 11 of the license, and asks that subscriptions at rates within the specified limits may at once be collected from all subscribers who are enjoying an effective exchange service. The Postmaster-General further considers the offer of money to subscribers of the National Telephone Co. at Burgess Hill by the chairman of the Telephone Committee to be a breach of Clause 21 of the license, and that it should be at once withdrawn. The Town Clerk, in replying, maintains that an effective service will not be obtained until 750 subscribers are connected, and the period of free service will last only until that number are placed in operation. He further states that the chairman of the Committee will act in accordance with the Postmaster-General's wishes, *i.e.*, withdraw the financial offer to Burgess Hill subscribers. It is satisfactory to note that the Postmaster-General maintains an impartial control over competing licensees.

There may be good ground for the Town Clerk's contention that the Corporation cannot accept responsibility for the chairman of committee's action on the ground that his "authority as Councillor and as chairman of the Telephone Committee ceases as soon as he leaves the Council chamber or the committee room as the case may be," but the Postmaster-General's view that he cannot dissociate the Corporation from responsibility will certainly commend itself to ordinary mortals. In the case of competitive municipal trading it is the excess of zeal which has to be guarded against, and the Councillor or chairman who claims even only average zeal does not confine his activities to the Council chamber. The existence of the spirit of enterprise in the councillor is the good and the evil of municipal life. In non-competitive public service, municipal zeal is a most valuable quality; in competitive business it is a great evil, and it is most unfortunate that such excess of zeal should be manifested on behalf of an enterprise so unsuited to competitive conditions as is the telephone service. It would be of interest to learn whether the estimates upon which the Brighton municipal telephone enterprise was started provided for that period of service without payment which the Town Clerk now recognises as so essential.

Electricity the Scapegoat Again.

As if electricians, who are notoriously loyal subjects, were not sufficiently grieved to hear of the unfortunate accident which befell Her Majesty the Queen last week, their enemies must needs set on foot the foul slander that the fire at Sandringham was due to what is known to the reporters of the daily Press as "the fusion of electric wires." So far as we have been able to ascertain, there never was the slightest foundation for this rumour. The cause of the fire was simply and solely the faulty construction of the concrete floor of a stove, situated in the room above the Queen's bedroom. Doubtless this fact was not discovered until time allowed of a proper examination of the scene of the accident, and, as usual, the well-worn phrase was utilised in the meantime. The repetition of such unfounded charges, as we recently pointed out, is calculated to do serious injury to the electrical industry, and to prolong the danger of fire by hindering the adoption of electric lighting and heating. We are confidently of opinion that had an electric radiator been in use instead of a combustion stove, the fire would never have occurred.

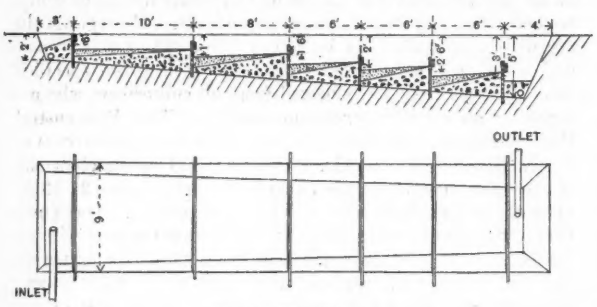
D

CENTRAL STATION ECONOMIES: THE UTILISATION OF CONDENSED STEAM.

By G. R. PARKINSON.

The advantages of condensing engines for central station work are universally recognised, but where reciprocating engines with surface condensers are employed, it often happens that the condensed steam contains such a large quantity of oil that it is impossible to use this water for boiler-feeding purposes; more especially does this occur on engines with forced lubrication, a quantity of oil getting on to the piston rod, and thence into the cylinder.

There are numerous appliances on the market for dealing with this difficulty, some of them treating the steam before it is condensed and removing the oil by a system of baffle plates, and others treating the water chemically, precipitating or rather coagulating the oil, and then removing it by filtration.



Simple Oil Filter.

I believe either of these systems can be made to deal with the water satisfactorily, but the cost of installation, especially if not allowed for in the original contract, is a consideration to most engineers, who wish to keep their capital expenditure as low as possible.

The simple filter, which I am about to describe, has the advantage of almost entirely removing the oil at an exceedingly small cost.

The filter can be constructed on any piece of waste ground near the station. Where the soil is clay the trench can be dug direct in the ground without any lining; where, however, the soil is porous, a lining of puddle will be required.

The chief point is that the filter should be big enough; the filter illustrated is capable of dealing with 2,000 gallons per hour.

The filter consists of a trench 43 ft. long, 2 ft. deep at one end and 5 ft. at the other. with the sides sloped down; the trench is divided into seven compartments by wooden partitions, each partition having about 20 1-in. holes bored through it 6 in. from the top, and the partitions are so arranged that the level of the holes in the second partition is 6 in. below the holes in the first, and the holes in the third 6 in. below the holes in the second, and so on. The discharge from the air pump is led direct to the inlet, and the outlet goes to the hot well. The filtering medium consists of clinker and ashes. The clinker from the fires is carefully sorted, broken and sifted and two heaps made, one consisting of pieces varying in size from 1 in. cube to 3 in. cube; the second heap consists of the screenings from the first heap, passed over a $\frac{1}{4}$ in. screen to remove the dust. The compartments are then filled up as shown, a few shovels-ful of fine ashes being put on the top, and the quantity of fine ashes being adjusted so that the water is obliged to flood about one quarter of the area of each compartment before it can get away. The surface of the ashes should be left with a slight rise towards the outlet end, so that as the filter gets clogged the water will rise slightly and flood a larger area; very little fine ash should be put in the first two compartments, or they will rapidly clog. With the average condensed steam, the first compartment will require cleaning about once a week, the second and third about once in 10 days, and the fourth about once a fortnight. For cleaning purposes it is advisable to have either a drain to each compartment, or a stand pipe arranged in which a hand pump can be fixed.

The water leaves the filter almost clear, and it is only when the water is over 1 ft. deep that any milkiness is observable. I have had the water tested by a leading analytical chemist, and he reported upon it as suitable for boiler feeding. Moreover, after running a boiler with this water for two months, there was no trace of oil in it when opened for examination.

When there is a large quantity of oil in the water, it is advisable to place a settling tank between the air-pump and the filter; not only does this make the filter keep clean longer, but the oil can be skimmed off the surface of this tank, filtered and used again.

It is advisable to make a small bye-pass filter alongside the main one, which can be used during the cleaning of the big one.

PROTECTION IN RELATION TO TRAMWAY ENTERPRISE.

The meeting of the Tramways and Light Railways Association, which was held on December 11th at the rooms of the Society of Arts, to discuss the question named above, produced speeches and arguments having no special bearing on the subject.

The hall was opened by an address from Mr. Atherley-Jones, who spoke in the Free Trade interest, and was twitted by Mr. Byng as being himself a member of the most highly protected trade in the world. Mr. Atherley-Jones, however, refrained from using his own class as an awful example of what monopoly and tariffs tend to produce. His arguments were of the usual stock-order beyond which it seems impossible to proceed. Mr. Moreton-Frewen, who followed on the Protectionist side, was equally convinced that the good of the Empire required us to levy tariffs. He did not regard dumping with that spirit of levity which characterised the first speaker, who, secure in his own protected citadel as a non-producer, appeared to lack sympathy with those ousted by dumping. As a matter of human sentiment this question appeals to many of us. A thousand gain an increase in employment as the result of dumping, and five hundred men are pushed down. How far is it good for the country at large that a thousand men should earn an extra 2s. per week if five hundred men are reduced from the status of skilled labourer to that of unskilled labourer at 10s. a week less wages. The Protectionist is often a man who lets these human sympathies influence him—to his credit be it said. Granted, he says in effect, that dumping makes the country wealthier; is wealth thus gained any advantage to a country?

"To numerous ills a prey,
Where wealth accumulates and men decay."

Mr. Arthur Wadham was heard with impatience; he read somewhat inaudibly from a voluminous packet on the Free Trade side, and was followed by Mr. Byng. The ill-behaviour and unseemly interruptions which characterised the meeting throughout came to a head during this speaker's period of grace. Mr. Byng, ignoring entirely his early days as an importer and dumper, was chiefly occupied with the ills he now suffers from compatriot dumpers. He now feels the effect of the lash he so ably welded when he was not himself a poor manufacturer, and his blood boils against Germany. In all this self policy no one thinks of the poor farmer, who has for years been exposed to the dumping competition of the mortgaged and dried-up farmer of Western America, who sells his next year's wheat to pay last year's mortgage interest. Fifty-six years ago the manufacturers howled down the farmer as a protected man. To-day he is crying for Protection for himself. The whole position is one of curious inconsistencies.

The speech of the evening was undoubtedly that of Mr. Ward-Humphrey, on the Free Trade side. It was rapidly and fluently delivered, and was altogether more telling than that of any other speaker. All who pointed their arguments with figures were unfortunate in their choice of figures, and isolated figures may on occasion prove anything. Each speaker ridiculed the other man's figures, and advanced others of equal doubtfulness.

The last speaker was Mr. Garcke, who was strongly in favour of fiscal change. A believer in Free Trade, he believed it should be secured by using weapon for weapon. Many Free Traders are of this opinion. All do not feel sure that it would succeed, but we know of many—call them wobblers if one will—who honestly believe that the British market is so valuable to the outer world, that to retain it they would easily listen to argument, backed by the power to retaliate. Sir C. Rivers-Wilson, in his speech, inclined to think that the tariff reformers had the better of the argument. But it is always easier to enlist sympathy for one unfortunate displaced workman than for ten who are bettered. If Free Trade and dumping is really good for the country; if its effect is so great that capital is really put out of use, and men are put out of work, and all this is done that the community at large may wax fat, can there be nothing done to compensate the unfortunate if small minority? Why cannot the community support a family while its anchor-forging bread-winner is taught to make needles—in the making of which the idle steam hammer, however, would appear out of place.

The whole question bristles with difficulties, but of all kinds of dumping that of the criminal alien and the foreign pauper who squeezes our own men and women upon the shores of America received no comment. Is there at the back of this call for tariffs a desire on the part of the chief wire-pullers to place us all, like so many American white slaves, under the heels of the Carnegies, Morgans and Russell Sages, the millionaire production of tariff-

ridden America? Mr. Ward Humphrey indicated the probability of this undesirable consummation, and do we not see already in Germany the strong development of the same undesirable conditions visible in America—the same greed, the same unprincipled business methods? Tariff reformers would do well to sufficiently realise this aspect of the question.

LEGAL.

Metropolitan Electric Supply Co., Ltd., v. The Mayor, Aldermen and Councillors of St. Marylebone.

In the Chancery Division of the High Court of Justice on Friday Mr. Justice Buckley had before him a motion by the Mayor, Aldermen and Councillors of the Borough of St. Marylebone, asking that the time which the Court fixed for the completion of the purchase by the defendants of the undertaking of the Metropolitan Electric Supply Co., Ltd., in that district might be extended.

Mr. Buckmaster, K.C., who appeared in support of the motion, said the Corporation, by virtue of the Electric Light Act, of 1901, became, as his Lordship had held, bound by Statute to buy the undertaking of the plaintiff company. The arbitrator made his award on February 4th last, and he adjudged that £1,212,000 should be paid to the plaintiff company as compensation. On June 23rd last the County Council declined to give their sanction to the raising of the money by loan. It appeared that one of the grounds upon which they refused their sanction was that, under the terms of the Statute, the defendant Corporation would have no power to work until after the completion of the purchase. An appeal was made to the Local Government Board, but before that appeal came on an action was brought by the Electric Supply Co. for specific performance of their contract. It was on his Lordship's judgment in that case that they now came to ask for an extension of time. The judgment declared that there was a binding contract created by the notice to treat and the award, and that the contract ought to be specifically enforced. The Corporation had submitted that it was quite impossible for them to raise the purchase money except by loan or by an increase of the rates. The rate necessary to raise this money would amount, apart from the other rates, to something like 20s. in the £. On September 28th, 1903, the Corporation had notice from the assistant secretary of the Local Government Board that that Board had no alternative but to uphold the decision of the County Council. The only remedy open to the Corporation was to go to Parliament again, and they resolved, on October 29th, to amend the Bill in order to get the proper and necessary relief. Under an Act which was passed this year, it was essential, before they could do this, to get the opinion of the ratepayers. January 28th, 1904, was the earliest date on which they could get this consent of the ratepayers, and February 18th was the latest date if a poll were demanded. The position at the moment was this: On December 31st, 1903, the Corporation was bound by the order of his Lordship to complete the purchase and pay money which they had not got, and could by no possibility get by that time. They therefore came to ask for an extension of time in order to see if they could obtain the necessary relief from Parliament by raising a loan which would enable them to carry out their part of the bargain. There was nothing which the Corporation had done which should disentitle them to the assistance of the Court. They had proceeded by every means in their power to raise the money, but, so far, they had met with defeat. The Bill would be deposited on the 17th of this month, but until the ratepayers had given their consent, the Corporation could do no more. If Parliament did not assist the Corporation, the only possible means of satisfying this purchase money would be by levying a rate which would be perfectly intolerable. It would dislocate the whole machinery of local government.

Mr. Cripps, K.C., who appeared with Mr. Astbury, K.C., and Mr. Sargeant for the plaintiff company, submitted that the Corporation of Marylebone had come under a statutory obligation to purchase the undertaking of the plaintiff company and the Council were given until January 1st to carry out the purchase. As regarded the means of obtaining the money, *primâ facie* the vendors had nothing whatever to do with that. The plaintiff company was entitled to the money, and if the Borough Council and ratepayers did not obtain borrowing powers it made not the slightest difference to the plaintiffs' rights in the matter. He was quite willing that on certain terms the Corporation should have an additional opportunity as regards borrowing the money. It was said the Council were now promoting a Bill which might or might not be accepted by the ratepayers. If it were accepted, and it became possible to comply with the standing orders and proceed with the Bill, he was prepared on behalf of the company to give all proper indulgence to the Borough Council on terms. So far as the company could see, and it was perhaps not improbable, the ratepayers might reject this application to obtain borrowing powers. Assuming the ratepayers did so, that had nothing to do with the vendors. The only other method of procedure would be for the Corporation to levy a rate for the purchase money. He asked that nothing would be done which would be to the detriment of the power which existed in the company at the present time. The company could, immediately after January 1st next, have taken the necessary steps to enforce their rights by mandamus according to the recognised methods. Proceeding, the learned counsel read an affidavit by the general manager of the plaintiff company, in which it was set forth that the company objected to the time being extended at all, except on the distinct undertaking of the Borough Council that in the event of the ratepayers refusing to sanction the proposed Bill before February 18th next, the Council proceed to levy a sufficient rate to discharge their obligations. The directors of the company had reason to believe that a considerable amount of opposition to the completion of the purchase existed in the borough, and they were, therefore, of opinion that any extension of time now granted should only be for a period sufficient for the defendants to ascertain the decision of the ratepayers on the Bill. They considered an extension of two months to February 29th next to be ample under existing circumstances. They desired a modification in at least four very important particulars of the terms upon which they consented in August last to the postponement of the completion of the purchase. The capital of the company consisted of ordinary shares, 4½ per cent. preference shares, 4½ per cent. first mortgage debenture stock, and 3½ per cent. mortgage debenture stock, but the capital expended to the present time considerably exceeded the capital raised, and in consequence of the delay which had already taken place in the completion of the purchase and of the uncertainty as to the date on which it would be completed, the company had been, and still were, unable to make provision for further expenditure on capital account required for any portion of their undertaking, including Marylebone, except by borrowing from their bankers at the rate of 4½ per cent. per annum, or by the issue of additional 4½ per cent. preference shares. At present the company owed large sums to their bankers on loans at that rate, contracted solely in consequence of the delay in completion of purchase which had already taken place. It was extremly inconvenient to the company financially to owe these large sums to their bankers, and still more inconvenient to increase these large borrowings to the extent of their further capital expenditure, which it was absolutely necessary to make from time to time, to meet the normal growth of the St. Marylebone undertaking, and to comply with the statutory obligations of the company. On the other hand, there were grave objections to issuing further capital of the company to meet a temporary necessity of the kind, and in view of the fact that all this capital, and a sum of over £1,200,000 in addition, would be thrown on the company's hands on the completion of the purchase. The capital expenditure incurred from December 31st, 1901, to June 30th, 1903, was agreed between the parties as being £67,250, and further capital expenditure had been, and was being, necessarily incurred, and a large portion of this capital expenditure was still unproductive. Under these circumstances the company submitted that as one term of any extension of the time for completion, the Borough Council ought to provide a sum of at least £60,000 toward the capital expenditure that had been, and was being so made. Such a sum only amounted to a rate of something like 9d. in the £ on the rateable value of the borough. It was obviously unfair that the company should, by the default of the Borough Council, and without any fault of their own, be not only kept out of their purchase money, but actually have to raise large additional capital for the purpose of maintaining an undertaking which really belonged to the Borough Council. The company also submitted that it was only fair that if further time for repayment of the whole or any portion of the capital sums expended by them on the Marylebone undertaking since December, 1901, until December, 1903, was granted, the rate of interest to be paid from the last-mentioned date until the completion of the purchase on such sums or the unpaid portion of them should be at the rate of 4½ per cent. per annum, that being the rate actually paid by the company. The company found that it was impracticable, in the ordinary course of their business, to submit every item of capital outlay for the approval of the defendants before the outlay actually took place. Various minor alterations in and additions to the plant, fittings and instruments in the stations and sub-stations had to be made from time to time, and often at very short notice, the cost of which alterations and additions, although small individually, probably would, by continued delay in completing the purchase, amount in the aggregate to a considerable sum.

His Lordship said the Borough Council had involved themselves in an enormous liability, and, unfortunately, did not find themselves in a position to discharge it. They ought to have thought of all this before they came under a statutory liability to purchase.

Mr. Cripps: We don't consider it is an unfortunate liability in a sense, if the Council had dealt with this matter on ordinary business grounds. We believe the income they would get would be quite sufficient to meet their liability. It must not be said that we look upon it as an unfortunate liability at all. The Council seem to have been disappointed with the award, and so were we. Proceeding, the learned counsel said the company had dealt with the business on the basis that the Borough Council would fulfil its obligations. The company had wished to be left in possession of the locality, but after five or six years' communication and friction between the Borough Council and the company, the former always saying they wished to purchase, the company had to give way, and a compulsory Bill was brought forward. The conditions accordingly were now changed, and the company were now going on another policy to that they followed five or six years ago. The ratepayers of the Council seemed to think that they could play fast and loose with the matter. The company wanted the situation clearly brought home to the minds of the ratepayers.

His Lordship: I think it is coming home to their minds.

Mr. Cripps said that the ratepayers had only got to realise what the true liability was. To end the whole matter the Council ought to get borrowing powers, and deal with the thing in a business way. If that were done there would not be the loss of a farthing to any ratepayer. If the ratepayers did not assent to what was really a business basis, and allow the powers to be got, in order that the purchase might be dealt with, as it was by thousands of municipalities in this country in the case of water and gasworks, they would have to take the consequences. The company would be forced in order to protect their interests to obtain a mandamus so that the necessary rate could be levied.

His Lordship: I cannot help thinking it was by inadvertance and oversight that the Council obtained the Bill. They did so without thinking of the consequences, and they are now face to face with the consequences. It seems to me that they are in very considerable difficulty. The levying of a rate sufficient to pay this purchase would be an oppression—that is, perhaps, not a correct word to use, but it would at any rate bear very hardly indeed on the ratepayers. It would be practically preposterous.

Mr. Cripps: The company don't want to take any unbusinesslike attitude at all.

His Lordship: It is for the Council to find the money, but at the same time it is for me to see that they are given a reasonable opportunity of complying with the obligation which, in my view, they have been very foolish to place themselves under. It is a complete satire on municipal trading.

Mr. Cripps, in the course of further argument, said that the company was at present in a state of suspended animation. He submitted that if the extension of time were granted, the terms which he had asked for should also be granted.

Mr. Astbury pointed out that until the money could be paid by the Council the company were in the position of having to remain in possession and carry on the works. They were under statutory obligations to do certain work and make certain connections, and were bound by the order of the Court to convert the system from the high tension to the low tension. It was common knowledge that if possible the ratepayers of Marylebone were anxious to get out of the contract. There was a strong agitation in the borough against it. Unless these ratepayers consented to the Bill for the borrowing of the money, they would have to bear the rate. It was not right that the ratepayers should be misled. The Council had actually refused their approval of certain expenditure which the company had been bound to make. If there were any liklihood or possibility of the works coming back to the company, the company ought to be allowed in the meantime to carry on the concern, as in the past. The company ought to have some part of this added expenditure paid to them at once. They suggested £60,000, and they should have the right to make reasonable and necessary expenditure in the conduct of the business, even if they did not get the previous approval of the Council to that expenditure.

Mr. Buckmaster, in reply, said that he wished to make it clear that there never had been any wish or desire on the part of the Council he represented to escape from this bargain. The company got the whole of the profits at present. If they were to retain these, it was a little hard to say that the Council should pay now part of the purchase money to enable the company to make these profits. He further submitted that there had been no withholding of approval as to expenditure by any of the agents of the Corporation.

His Lordship, in giving judgment, said the Council's difficulties began with the arbitration award. They seemed to have gone to Parliament with a light heart to get an Act to compel them to purchase. Of course the Council had not got the money, and they failed to get sanction to borrow it. Since the judgment under which defendants were ordered to complete the purchase on December 31st the Council had to the best of their ability tried to raise the money. As the sum was very large, the levying of a rate would be a very heavy burden indeed on the ratepayers, and he was not at all surprised that the Council were not prepared to face the ratepayers with such a rate. The company said that the Council having entered into the bargain it was no affair of theirs how the money was to be raised. The vendors, he continued, were quite right, and the Council should have thought of how they were to raise the money before they obtained the powers. The Council had presented a Bill in Parliament, which would or would not be capable of going forward according to whether the ratepayers did or did not approve of the Bill. If they did not do so the situation would become even more acute. Meanwhile the company proposed to enforce the contract, but at the same time they said it was competent to Parliament to do anything, and if the municipal authority had entered into such a bargain as was oppressive to the ratepayers it was possible for Parliament to relieve them of the contract on proper terms. It was not an impossible event that the sale might never be carried through. He thought it right to extend the time for completion to the end of February, but as it was necessary from time to time for the company to spend money on the undertaking, and they had had to borrow a large sum from their bankers at 4½ per cent. interest to make the Borough Council masters of the situation, when the plaintiffs were compelled, through no fault of their own, to extend the time, he would extend the time for the completion of the purchase until February 29th next on the terms that £60,000 should be paid by the Council to the company on account of capital expenditure (£60,000 being an equivalent to a rate of 9d. in the £), that 4½ per cent. interest should be paid on £7,250, which had also been expended, and on any further capital expenditure and that there should be added to the purchase money such further and other expenditure as plaintiffs should make in respect of reasonable and proper expenditure on capital account, subject to the company proving and vouching that expenditure as being necessary and proper. The Council would pay the costs of the motion.

Geipel & Lange *v.* Manchester Corporation.

Mr. Justice Swinfen-Eady, in the Chancery Division on Saturday, gave judgment in the above action. The plaintiff was the holder of letters patent relating to inventions and improvements in steam traps, and he alleged that the defendant corporation were using in their electrical power stations steam traps which infringed his patents. It was urged by the defendants that all that the plaintiff had done was to take a well-known mechanical contrivance and apply it to a subject to which it had not hitherto been applied, and that there was no invention in that.

His Lordship, in giving judgment, said the plaintiff's invention was simple, ingenious and effective, and had made the apparatus more reliable and durable than before, and his claim was a very restricted one, being only for a particular combination of a lever and spring with a valve. In his opinion, the arrangement of the new combination required the exercise of considerable ingenuity. The defendants had pleaded a large number of prior publications, none of which, however, were anticipations of the plaintiff's invention. The new combination was a proper subject matter, and the patent was valid. Mr. Berry, whose invention plaintiff complained of, had recognised its value by manufacturing an almost exact copy of it, which was used by the defendants. The plaintiff was entitled to an injunction, the costs of the action, and an inquiry as to damages and profits.

Knight *v.* The Isle of Wight Electric Light and Power Co.

In the Chancery Division of the High Court of Justice on Tuesday (December 15th), Mr. Justice Joyce resumed the hearing of this action.

Mr. Hughes, K.C., proceeded to address the Court in reply on behalf of the plaintiff.

Mr. Justice Joyce said that the question was whether the nuisance was occasional and temporary, and he would have to consider whether the plaintiff was entitled to an injunction at the time the action was instituted. There might have been a nuisance when the works were started, but whether what had been done cured it, he would have to consider.

Mr. Hughes, K.C., said his case was that the nuisance had not yet ceased, that it still existed when the wind was in a certain quarter. Dealing with the legal authorities, he submitted that "occasional and temporary" meant what it was known could be of that nature, and not a nuisance, which it was only hoped could be cured by steps it was in contemplation to take. The owner of property must put up with the inconvenience caused by the ordinary use of his neighbour's property; but that did not prevent him from recovering damages in respect of extraordinary use.

Mr. Justice Joyce remarked that there was no question that a man must use all reasonable means to minimise any inconvenience from the use of his property to his neighbours.

Mr. Hughes said that "temporary" did not mean for ever, and did not include any case where it was a matter of experiment and trial to see whether the nuisance could be put an end to. In the present case it was admitted that the plant of the defendants was novel, and that the engine was the first of its type. On the evidence, he submitted, it was clear the nuisance had been dreadful for several days, and that, therefore, he was entitled to an injunction, and an inquiry as to damages.

Mr. Waggett was allowed to say a few words as to the law on behalf of the defendants. He contended that occasional and temporary meant in connection with the construction and getting into working order of any works.

Mr. Justice Joyce: Where is there any case to that effect? You want to make a new precedent, it appears to me.

Mr. Waggett said he could not find any case, but he thought the reason for that was that in other cases people had not begun actions in the tremendous hurry which the plaintiff in this case had shown.

Mr. Justice Joyce said there had been a great many injunctions granted.

Mr. Waggett said that, in the cases in which injunctions had been granted, the nuisance had been going on a very long time before the matter had been brought into Court.

Mr. Justice Joyce said he would consider his judgment, and judgment was therefore reserved.

Ferranti, Ltd.

In the High Court of Justice on Tuesday, Mr. Justice Buckley, sitting for the disposal of companies' business, had before him an application on behalf of a creditor of this company asking for the production of certain documents referred to in an affidavit filed on a petition for liquidation.

Mr. Buckmaster, K.C., for the petitioner, said he was a creditor for dishonoured bills, and he had presented a petition for the winding-up of the company. The answer put into that petition consisted chiefly of an affidavit by certain receivers who had been appointed in a debenture-holder's action. They had been appointed on September 9th, 1903, and the main ground of their objection, as disclosed in their affidavit, was the allegation that certain contracts, of which the company had the benefit, contained clauses, which would cause the contracts to be forfeited in the event of a winding-up order being made. On that affidavit being served, it was suggested that the creditors should call a meeting to consider what should be done. The petition accordingly stood over for a fortnight till the creditors' meeting was held. At that meeting a committee was appointed, one of the members of that committee being the petitioning creditor. On December 1st his Lordship allowed a further adjournment until the first petition day of next sitting in order to see if this committee would recommend any course. Several applications had been made to the solicitors for the deponents who had sworn the affidavit asking for liberty to inspect the documents, but the petitioning creditor had been unable to obtain inspection of them.

Mr. Vernon, for the receivers and managers, said they were really no parties to these proceedings at all. He submitted that what they had done was perfectly right in the circumstances. They

were willing to give any reasonable information, but they considered it undesirable and detrimental to the interests of the company that such contracts should be produced. They were further instructed that the company could not conduct its business if these contracts were taken from the works at Manchester. If copies were made it would lead to very considerable expense, and would be an oppressive proceeding.

Mr. Buckmaster said he wished to see the forfeiture clauses.

Mr. Vernon said he was perfectly willing to give verified copies of these as well as the dates of the contracts. The reason the receivers and managers were so cautious was because Mr. Ferranti and Mr. Anderson had specially warned them that it would be detrimental to the company to produce any contracts relating to the works. There was danger of these becoming known to competitors in the trade.

Mr. Buckmaster said that the petitioner was Mr. Estler, and the petition was in respect of goods supplied. He did not carry on business in competition with the company, nor was he in a position to undertake the work.

His Lordship said it was perfectly reasonable that the contracts should not be produced. The receivers and managers must, however, give copies of the forfeiture clauses, and, so far as possible, the dates fixed for the completion of these contracts. The costs would be costs in the petition.

G. F. Milnes & Co.

In the Chancery Division on Tuesday, before Mr. Justice Farwell, Mr. R. J. Parker, in a debenture holders' action of the Bank of Liverpool, Ltd., *v.* George F. Milnes & Co., moved for judgment in default of defence. The bank holds a third debenture and the whole series of the second debentures, while the Law Guarantee and Trust Society was trustee for first and second debentures. An interim order had been made for the appointment of a receiver and manager, and counsel asked that this appointment should be continued in chambers. It was one of those cases in which, no doubt, everybody would be paid, and the bank was meanwhile advancing the money.

His Lordship gave judgment on the minutes submitted, which were in the usual form, with a declaration as to the bank's charge, and the customary inquiries.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Design of Continuous Current Variable Speed Motors.

With reference to the paper on "Speed Variation of Continuous Current Motors by Shunt Control," by H. M. Hobart, appearing in your issue of December 4th, whilst in general agreement with the views of the writer as to the proper method of rating variable speed shunt wound motors, there are one or two points to which I should like to draw attention.

It appears difficult to reconcile the statement that the limit of output of the small motors depends on the sparking point only, and is independent of temperature considerations with the present practice of rating motors for crane work at two or even three times their normal rating. Such motors must carry this increased output without sparking and with unfavourable conditions as to variation of load. If it were not for the fact that the motor would have too great a temperature rise, there appears to be no reason why these high ratings should not be taken as the normal rating of the machine. Apart from this point it seems quite certain that in most small motors designed on the usual lines, the temperature rise, and not the sparking, is the limit of output. Believing this, it is interesting to find that one can, nevertheless, be in full agreement with the way in which Mr. Hobart lays stress on the fact that high speeds do not bring about a correspondingly increased output, he basing this view solely on considerations of commutation.

In a paper read by Mr. H. A. Mavor before the Glasgow Local Section of the Institution of Electrical Engineers, November, 1902, it is shown that working on formulæ relating only to the temperature rise of the armature, curves can be drawn showing the relation of output and speed, which prove very unmistakably that, for any given armature and any specified temperature rise after a certain speed has been reached, the output actually decreases with increase of speed, and that, therefore, for any given output, there are two speeds which will give the same temperature rise. Naturally, from every other consideration, the lower of the two speeds is to be preferred.

One can, therefore, endorse Mr. Hobart's views as to lower speeds than usual being advisable, without agreeing with him that sparking is the limit of output.

Another point is the increased stringency in specification which Mr. Hobart advocates. It would almost appear at first sight as if Mr. Hobart held that the increased stringency in specifying that the brush position should not only be fixed for all loads, but should be fixed at the "geometrical neutral point," was an actual advantage to the manufacturer in designing variable speed motors. Probably he only means that such a specification becoming usual would put all manufacturers on the same footing, and would result in a more satisfactory line of motors generally, for it seems evident that if a motor does not comply with this specification, it can only be made to do so by spending more money on it, either by increasing the diameter or by further sub-dividing the commutator parts, whilst in practice the fact of the brush position coinciding with the geometrical neutral point is of no advantage to the user if the motor is not to be run in both directions. From a manufacturer's point of view it would seem that specifications are already quite sufficiently stringent, and that it is undesirable that any addition be made to present requirements unless they are really necessary for the improved working of the apparatus.

W. B. Hird.

Glasgow, *December 9th*, 1903.

Heating Capacity of Electric Radiators.

With reference to your editorial note to our letter in your issue of December 4th, doubtless your expression "convector" more accurately describes the low temperature system. Surely a system that only warms the air with the moisture it holds in suspension is better than one in which the moisture is vaporised and recondensed.

A "convector" that raises a large volume of air through a relatively low number of degrees must be less "artificial" than the alternative of baking a small quantity and diffusing it with the colder air.

As to the interesting letter of Messrs. Falk, Stadelmann and Co., inefficiency in a lamp or motor is due to the dissipation of energy in useless form, and as you have already pointed out this does not apply to heaters.

Since our radiators do not age and require no repairs, the suggested comparative tests would have to last over the life of the "Phœnix" heater.

The Electric and Ordnance Accessories Co., Ltd.
R. F. Hall, *Manager.*

Aston, *December 9th*, 1903.

[We may point out that the moisture contained in air at a temperature above the dew-point is not held "in suspension," but is already true vapour. It is, in fact, strictly speaking, absolutely identical with superheated steam. Moisture "in suspension" produces mist, and is visible.—Eds. Elec. Rev.]

Your remarks regarding mis-description in the issue for November 27th were timely, though, perhaps, hardly strong enough. Mis-description is inexcusable enough in an advertisement, but becomes serious when affixed to the apparatus.

I have lately tried a radiator of the Phœnix make, and have nothing to say regarding its heating capacity. The makers, however, seem to have been under a curious misapprehension when affixing the description plate.

The radiator was shown in the list and purchased as one taking 400 watts. It is marked—"2 amperes, 200 volts," and, when all the coils are in circuit, it *does* dissipate 400 watts. As an extra convenience, however, there is a two-way switch on the radiator, one position of which cuts out one-half of the coils (which are all in series), presumably to give a half-power heat!

The result of this simple arrangement is, of course, that *800* watts is taken.

The actual figures were 430 watts and 810 watts, voltage 204; no lamp in radiator.

C²R.

We had thought that the correspondence regarding this matter would have ceased after the publication of our letter in the columns of your issue of the 4th inst., but we trust you will afford us an opportunity of passing a few remarks on the Prometheus Co.'s letter, appearing in your last issue.

We certainly made a promise that we would lend them one of our radiators for the purpose of testing, but this promise was made upon the distinct understanding that correspondence in your columns should, for the time being, cease, and when we heard from them that they had written you again upon the subject, we withdrew our offer.

The Prometheus Co. state that they are well aware what the results of a comparative test would be. It may interest them to know that we are also aware of what the results would be, and, unlike them, we are not speaking without some actual knowledge of what their stove can do, having already gone to the trouble of testing the same, with ours.

Although we have withdrawn our offer to lend them one of our radiators, should they still be anxious to make a test, our proposal, which appeared in your issue of the 4th inst., is still open for their acceptance.

Falk, Stadelmann & Co.
G. E. Garbe.

London, *December* 15*th*, 1903.

Technical Instruction.

I am afraid that, between "Arc" and myself, the correspondence on Technical Instruction is being gradually dragged into one upon the relative merits of theoretical and practical teaching. However, I would like to say a few words in answer to this gentleman's letter. The short note at the end of it by the editors gives a very fitting answer to his views. In the first place, I think that the number of technical schools in this country is few, where only two hours per week of practical instruction are given. I know of 12-13 hours being devoted to workshop and laboratory practice. Again, if "Arc" will look at my first letter, he will see that I never did accuse him of saying that the half-workshop, half-University trained man was unqualified to hold the position of technical instructor. Anyone could see, from the tone of his letter, that he would like the wholly workshop-trained men, and these alone, to get such appointments. I hold no brief for the wholly theoretical man, as he seems to imagine, nor yet for the other side, but am simply trying to state that the "right men" must have both classes of training.

Who are the most valuable to a progressive nation—your Edisons, Stevensons and Watts, or your Faradays, Maxwells and Kelvins? While "Arc" would not hesitate to give an answer in favour of the former, I should beg to differ. One set is as valuable as the other. The progress of the nation would be slow—very slow—with one class alone. Is it likely that, at the present day, there would have been such a universal use of the electric current, if such men as Faraday had never lived? Can the electrical engineering industry really progress without the co-operation of pure science? Could a man, most proficient and well trained in the practical applications of electricity, but without the true knowledge of the real nature of the current and its forces, construct such a machine as a dynamo or induction coil, if he had never seen one before?

No, Sir. The head and hand must work together, the latter applying the result of the work of the former. In conclusion, I would say that I thoroughly concur with "Arc" in the last paragraph of his letter.

W. L. Turner.

London, *December* 13*th*, 1903.

[This correspondence is now closed.—Eds. Elec. Rev.]

Waste of Energy in Tendering.

Correction.—We have been asked by Mr. A. H. Dykes to mention that in hurriedly signing his letter on the above subject, which appeared in our last issue, he inadvertently used the signature of his firm instead of his own name; the letter was written in his private capacity.—Eds. Elec. Rev.

Electrical Contractors and Manufacturers.

I notice in your issue of the 11th inst., a correspondence on the above subject between Messrs. Rashleigh Phipps and Co., and Messrs. Ernest F. Moy, Ltd.

This correspondence would give an erroneous impression to your readers of the actual position, and I do not think it would have been written had Messrs. Ernest F. Moy, Ltd., made inquiry from either Association mentioned as to the facts. Messrs. Moy are wrong in believing Messrs. Rashleigh Phipps responsible for anything whatever connected with the Association I represent. This Association is not "one and the same body" as the Electrical Contractors' Association; it has many objects to carry out for the benefit of its members, even if it had not come into contact with the Contractors' Association.

When this, the Manufacturers' Association; was established, there was no idea or intention of coming to any arrangement with the Contractors' Association, this was an outcome of what was found to be desirable for the benefit of the electrical trade. Until I saw your issue of the 11th inst., my Association had no knowledge of the correspondence in question.

W. Davenport, *Secretary,*
The National Electrical Manufacturers' Association.

London, S.E., *December* 15*th*, 1903.

I should think that Messrs. Ernest Moy & Co., Ltd., were justly indignant at Messrs. Rashleigh Phipps & Co.'s threat.

From what I gathered at a meeting of the E.C.A. a few weeks ago, the time had come when the contractor should be honestly recognised by those large manufacturers and factors who "supply anyone," *i.e.*, private individuals, consulting engineers, architects, &c., with fittings, lamps, and even accessories at all and various prices, ignoring the very person who has to invariably rely on the trade discount for his profit.

This very important grievance, which is banding together the contractors, cannot obviously apply to heavy switchboard makers, and no doubt the letter or circular complained of was sent in error.

Edward H. Welch.

London, N.W., *December* 15*th*, 1903.

With reference to the correspondence between Messrs. E. F. Moy, Ltd., and ourselves, published under the above heading in your issue of the 11th inst., we are pleased to note that you invite correspondence on the matter, and gladly avail ourselves of the opportunity to correct the numerous errors contained in Messrs. Moy's letter.

As a commencement we would point out that every single statement in their second paragraph is entirely and absolutely incorrect. Mr. Phipps is *not* "one of the gentlemen responsible for the formation of the National Electrical Contractors' Association," and, as a matter of fact, his connection with that body did not commence until some time after its formation. So far from being responsible for the formation of the National Electrical Manufacturers' Association, he is not, and never has been, in any way connected with that body. Messrs. Moy's presumption that these two associations are one and the same is entirely erroneous, and, on the face of it, absurd; and so far from one association being useless without the other, the fact is that the two associations were formed entirely independently, and for entirely different objects, and it is only during the present year that they have had any dealings together. This makes clear the absurdity of regarding our letter as a semi-official communication from two distinct associations, when we are merely ordinary members of *one* of them, and robs Messrs. Moy's offensive reference to "contemptible means to gain members to the ranks" (of the Manufacturers' Association) of any semblance of meaning, seeing that it is a matter of complete indifference to us whether they join that Association or not.

As regards the afore-mentioned dealings between the two Associations, the object of these has been solely to remove certain causes of friction between members of the two bodies, and promote a better feeling generally—results in every way desirable, and which we believe to be largely attained by an agreement which has just been arrived at, the provisions of

which are intended to be mutually beneficial to members of *both* Associations. This being so, it appeared to us to be a friendly action to suggest to several firms of manufacturers with whom we had dealings that they should put themselves in communication with the Secretary of the National Manufacturers' Association, to inquire into the matter with a view to sharing in these benefits, and we cannot imagine any "business firm run by business men" rejecting the idea without first taking the trouble to inform themselves concerning the same; but then of course it is hardly the action of a "business firm run by business men" to send a letter to the public Press bristling with mis-statements which the most casual inquiry would serve to correct.

We may mention that immediately upon receipt of Messrs. Moy's letter, we wrote them pointing out these mis-statements, but apparently in their haste to rush into print they did not think fit to wait for our reply.

With apologies for trespassing so far upon your valuable space in a matter which, but for Messrs. Moy's action, we should have been inclined to consider as purely personal—

Rashleigh Phipps & Co.

London, *December* 16*th*, 1903.

Re Walsall Switches.

In reply to your correspondent's letter in your issue of the 11th, we did not know before reading their letter that there was another switch on the market identical with ours; further, we assure Messrs. Richardson that never having seen one of their switches, or even having heard of the firm, we are not guilty of copying their design.

In conclusion, may we ask the "original makers" when they first put this switch on the market, as by stating this they may prove their claim to the title they assume.

The Walsall Electrical Co., Ltd.

Walsall, *December* 14*th*, 1903.

Electric Shocks on Flat-Back Switchboards.

I am, to say the least of it, very much amused at the letters in your recent issues on the subject of the mysterious "H. W. C." Anyone who knows "H. W. C." knows Mr. P. B. Aimer and their ardent support of the cellular type, but I would take exception to both of their remarks as to the absolute security of this type.

One instance—Leeds. About 12 months ago by the merest miracle a man escaped with his life "by the skin of his teeth," as the saying is. He "accidentally" short-circuited two bus-bars, I believe.

How did he do that, one would like to know? Perhaps such an ardent supporter as Mr. Aimer can explain?

Both types have their advantages, of course, but for it to be claimed that one holds the record is not quite right, is it?

Enquirer.

Variable Speed Continuous-Current Motors.

Most of your readers, on reading Mr. Broadbent's letter of the 30th ult., would receive a wrong impression of the term "double roll" as used in printing.

To double roll a machine you do not *reduce the speed*, but print every alternate cycle, thus reducing the output by half. Automatic "double roll" gear has been done away with on all modern machines, as the colour capacity of the machine has been increased, it has more sensitive gear, and by reducing speed of machine so as to get a longer period of impression, the printer attains the same end, the output of the machine being about 25 per cent. less.

A modern machine runs from 1,600 to 1,750 per hour, and its heaviest work can be done at 1,250 to 1,400 per hour, and this is the practical range of speed control that motors should possess when put to flat-bed machines. Stop-cylinder presses run at a maximum of 1,200 per hour.

As regards Mr. Broadbent's views as to speed range, I quite agree with him that variable control beyond the limit mentioned is a costly fad and a delusion.

But to a printer who attaches some value to the appearance of his work, the life of his machine, freedom from breakdowns, worry and anxiety, variable speed control is of great importance. Many of the evils that occur in printing are due—and solely due—to running every job, be it light or heavy, at maximum speed. And, by the way, many minders and overseers have little or no idea of the heavy strains that are thrown on the machine in so doing.

Trusting this may be of some use to your readers—

Ed. Eberwein.

Croydon, *December* 14*th*, 1903.

The Working of the Maximum Demand System.

We have recently had fitted to an installation run from a corporation supply, at 220 volts direct, one of the Reason Co.'s patent three-wire demand indicators. Readings are taken daily of current consumed, and also of the height of the demand indicator. During November the maximum demand was 2,200 units = 100 amperes with all lamps burning. Now, with the same lights, it has increased to 2,300 units = 105 amperes, within a fraction. As it is impossible for an increase of 5 amperes to occur with exactly the same lights in circuit, we should be pleased to hear from anyone who has noticed the same thing with any demand indicator. The difference in the charges being £2 10s. in place of 16s. 8d., you may imagine it is a matter of some concern to consumers. If it is caused through a drop in the voltage from the Corporation supply, are we not entitled to take the lowest reading as correct?

H. M. Hoyles.

Middlesbrough, *December* 14*th*, 1903.

[We fail to see anything surprising in these results. The replacement of a few of the lamps (over 500 8-c.p. equivalent) by new ones, possibly less efficient, or by lamps of a higher candle-power—a common occurrence—an accidental rise of voltage of only 3 per cent. at the moment when all the lamps were on, or a combination of these conditions, would easily account for the difference in the maximum demand. We fear our correspondent will not find it so easy to induce the Corporation to accept the lower reading.—Eds. Elec. Rev.]

Design of Direct-Current Machinery.

Mr. Fynn states only the effect on the brush-holder of running the motor in the direction of the inclination of the brush, and he does not consider the effect on the commutator.

Referring to Mr. Fynn's sketches again, in fig. 1 with the armature revolving with the inclination of the brush, and in a clockwise direction, the brush acts as a wedge between the side "*b*" and the commutator. Such a condition is liable to cause very serious heating of the commutator on account of the greatly increased friction. On several occasions cases have occurred where the commutator was heated up to such an extent as to cause the leads to become unsoldered from the commutator segments. To remedy this, either the direction of rotation has been changed, as in fig. 2, or the brushes altered so that the inclination was against the direction of rotation. The result in every case has been that the commutator has run with its normal heating.

But, in dealing with this question, everything depends on the angle at which the brush is inclined. Practically, carbon brushes are made for inclinations up to 45°, depending on the designer. From the wide differences of design noticeable between the machines of different makers, it seems almost as if the angle of inclination used were decided on from the mere whim of the designer, and without any real attempt at suiting the angle to the conditions involved.

There are two component pressures to be considered; first, the pressure of the face of the commutator on the brush, which acts on a line through the centre of the shaft, and the point of contact of the brush; secondly, the force equal and opposite to the tangential force due to the friction of the brush on the commutator. These two pressures are at right angles to one another. The resultant pressure on the brush is, of course, the resultant of these two components. The direction of the resultant pressure is found from the value, $\frac{\text{tangential pressure}}{\text{radial pressure}}$, which gives the tangent of the angle of inclination of the brush. This is at the

same time the value for the coefficient of friction. The angle of inclination, therefore, depends entirely on the value of the coefficient of friction, the two values being numerically the same. This fact makes the angle absolutely independent of the speed of the commutator. Where carbon brushes are concerned, it has been found from a long series of exhaustive tests, which the writer has now before him, that the coefficient of friction remains constant for all speeds of commutators which are practically possible. With copper brushes this is not the case, the coefficient of friction decreasing with the speed, but copper brushes being fixed, their consideration does not enter the discussion.

The following table gives the tangents of the angles of inclination :—

Angle of inclination.	Tangent of angle = coefficient of friction.
10°	·177
15°	·268
20°	·365
25°	·467
30°	·578
35°	·701
40°	·84
45°	1

Now for carbon brushes on commutators, a good average value for the coefficient of friction is ·25, varying from about ·15 minimum to ·3 maximum. With graphite brushes the average value is considerably higher, being about ·375, varying from about ·3 minimum to ·5 maximum. From this, it will be seen that the useful inclination is about 15° with carbon brushes, and about 20° to 25° with graphite brushes.

There are one or two considerations why it would be advisable to decrease the angle of inclination, and, again, one or two considerations why it would be advisable to increase the angle; but these offset each other, and for all practical purposes, the angle of inclination may be deduced from the value of the coefficient of friction. If the angle is increased beyond these limits, no real advantage is gained when the machine is running *against* the inclination of the brushes, and it is practically impossible to run the machine *with* the inclination of the brushes on account of the damaging effect to the commutator from "wedging" and to the brush-holder from pitting.

G. N. Thomas.

Rugby, *December 14th*, 1903.

South African Affairs.

As a South African colonist of many years' standing, with fairly constant visits to the "Old World" to prevent mental rust, your leader, "Our South African Market," of the issue of December 4th interests me. I think it is impossible for an Englishman sitting at home, and who has not had a lengthy Colonial experience, to enter into our constant worries with manufacturers at such long range without misjudging. There is first and always the "infallibility" of the English manufacturer, who knows better than you do what is suitable for climates, situations and conditions he has never seen, who has one standard—the best—and refuses to leave his well-worn groove. This often wastes valuable time, and makers do not seem to appreciate the vast distances to be bridged in correspondence. They have absolutely suicidal tendencies, and do not mind in the least leaving one in the lurch, as, for instance, the following :— Some time ago, after much negotiation, I managed to secure an order for a certain machine (we need not be too definite; as a matter of fact, a kind of road roller) from one of the Colonial Governments. To those unacquainted with the inner workings of Government orders, I may mention that this entails a good deal of correspondence and some interviews to calm the fears of the powers that be of "trying experiments," which is their great bugbear, and to have the necessary amount placed upon the estimates for the ensuing financial year. After receiving the provisional order, with the promise of all others, if successful, you may imagine my disgust to receive a letter from the makers that they had found it necessary to make certain alterations in the design, and that they were too busy to do this at present, and could not take any orders, as they were working overtime in other departments! Now, I had introduced this firm's manufactures into South Africa, and spent many hundreds with them. Fortunately for me, I had done a good deal of business with the Government department in question, or I should have appeared a considerable fool.

If I may be allowed to criticise, I would say that English makers do not carry sufficient, or very often any, stock. I have hunted all England through for a matter of three coupled engine-dynamo sets for ship lighting. This was during the war, when the price was a secondary consideration, but I had to wait seven weeks, ten weeks and three months, and then had two left on my hands. Fortunately I had a few sets in hand just before this. Neither do they standardise and stock repair parts like the Americans and Germans; or pay sufficient attention to the fact of much hotter engine rooms, and in packing they have much to learn from the Yankees. A small thing, perhaps, to an English packer, but it meant about £100 loss to me, was this: three 16-in. induction coils arrived in pieces from the simple omission to place proper battens in the cases. I could multiply this *ad infinitum*.

I always find American and German firms exceedingly pushing and intelligent, deluging one with well got-up printed matter, blue prints and details. Americans, especially, are wonderfully perfect in the matter of standardisation of repair parts, supplying copious catalogues illustrated and numbered down to each individual screw and washer.

American castings are so clear and perfect that, from an Englishman's point of view, they take advantage of this fact and chuck in castings, in arc lamps, for instance, to use one illustration, which, in English work, would be all tooled. This often goes against one's stomach, and gives one an initial dislike, and sometimes a permanent one, but after lengthy trials such lamps work well, and "the proof of the pudding is in the eating."

You will always find these nations fully to the fore in the latest practice. As regards packing the American even over does it. I remember a small 10-KW. multipolar-coupled set I had from the States which reached me packed in more than 20 cases. In large sets they always take everything to pieces (knocked down), and they had followed this out most religiously, each field coil being in a separate case of *double wood*; the marble switchboard in a triple case, the board itself wrapped in paper, packed in a light case, this other case wrapped in tarred felt, zinc lined and packed in a third case. Elaborate, you may say, but very perfect for up-country journeys; and a slight difference to an English dynamo weighing 2 tons I had to get on a fourth floor of a factory with only a 1-ton lift, and no other means of getting it up. This was a job I shall not forget.

I also remember to my cost a consignment of 60 large arc-lamp globes from England (imported straight from "Liebe Vaterland" as the paper packings showed, although the senders assured me they had sent them from stock when I asked why they had not been shipped from Hamburg). These were two in a barrel, and I received 17 whole ones! Prime cost each 21s.; packing, commission, freight, primage, duty, landing, wharfage and carriage came to considerably over 100 per cent. Anybody with a real taste for mathematics can calculate what those 17 globes cost apiece! As for accumulator boxes, I have had more than once to order the normal number three times over to receive sufficient to complete the job in hand. It is no good talking about insurance. This is too long a tale. My experience is to pay only F.P.A. rates. If you are silly enough to pay against all risks—a very heavy annual charge—you will find in the end it is a useless safeguard. Under the shipping rules, your claims are only paid if the cases are broken, and the same are opened in the presence of a surveyor and the shipping company's representative.

One more instance and I have done. A coupled dynamo and engine set of about 40 KW. for a Government department, built to my specifications, duly arrived with the test sheets showing that they had been run together satisfactorily. Yet that engine and dynamo never had been run together; the dynamo probably had been belted to shafting, as they each ran in reverse directions, and there was not sufficient wire on either fields or brush-rocker until we added it, to reverse the direction. Also the engine governed at one speed and the dynamo gave its output at another—a difference of over 100 revolutions. This necessitated a change of pulleys.

Yes, I think the Englishman might give a little more thought to his relatives across the water, and remember how far we are away from the factory. Not, for instance, forwarding a voltmeter for 120 volts reading, with no reading below 20, for their alternator exciting circuit which took current at 20 volts.

As I have friends in both places, as the parson stated, I prefer, in this instance, to subscribe myself

M.I.E.E.

Steam Turbo-Generating Plant.

Mr. Morcom, in his latest letter on the above subject, quotes the fact that, for the year 1902, the cost of coal at Scarborough was ·85d. per unit, while at Cambridge, with a less output and a lower load factor, it was only ·66d., as a proof that load factor and presumably output also have "no very close bearing on the relative economies." He adduces this in support of the utility of his comparative tables, in which, as I have shown, his selected reciprocating engine stations have, on the average, a 50 per cent. better load factor and a 100 per cent. greater output than the turbine stations. Now for the year 1902 the Scarborough load factor was only about 2½ per cent., and the output only about 5 per cent., better than the corresponding Cambridge figures, and while 2½ per cent. and 5 per cent. differences may very well be masked by other conditions, this is not so likely to be the case where it is a matter of differences amounting to 50 per cent. and 100 per cent.

Mr. Morcom's whole argument on this point is illustrative of the extreme danger that attends his method of making comparisons between stations as to the precise circumstances of which he is necessarily very ignorant. He could not very well be aware of it, but the reason for the superior fuel economy attained at Cambridge over Scarborough in 1902 is perfectly well known to me, and was simply due to the fact that during a considerable portion of the year in question Cambridge was working with much larger, and therefore more economical, units of plant than were in use at Scarborough.

The effect of this was to more than counterbalance the slightly superior load factor and output of Scarborough, which, by themselves, would of course have a contrary tendency.

Further, in objecting to my criticism of his comparisons on the score of load factor, Mr. Morcom is not consistent, when it suits his own purpose, as in the case of the comparison he makes between Leeds and Newcastle, he himself calls in the matter of load factor to support his argument.

What is, however, altogether amazing, is that Mr. Morcom appears to be ignorant as to what is really meant by the term "load factor" in connection with ordinary electric supply stations. He surmises that the inequality in the load factors that I have pointed out "might be due to anxiety on the part of the turbine stations to hold a big margin of spare plant." What in the world has spare plant to do with load factor? As everyone knows, it is a matter not of plant capacity nor of special load, but of ordinary maximum load actually ascertained in practice. The poor load factors at Cambridge and at Scarborough are easily understood when one remembers that at Cambridge a large part of the output goes to colleges which are practically shut up for about half the year, while Scarborough is a watering place with a very short season in the summer months, where the maximum load in kilowatts actually occurs in the beginning of September instead of in December, with its much shorter days, as is the case in most places.

No doubt, both at Cambridge and at Scarborough at the end of the year 1902, the amount of plant installed was considerably in excess of actual requirements. The reason for this was two-fold, viz., a considerable provision in each case for extension, and also the fact that in both stations some new and much larger, and consequently more economical units of plant, had just been installed to replace the original smaller units which sufficed when the load was less, which smaller units had not then been removed, as has since been done to a considerable extent.

Here, again, we have an illustration of the way in which Mr. Morcom is arguing about places with the special local conditions of which he is evidently entirely unacquainted. This is further evidenced by the fact that among his selected reciprocating engine stations he included Salisbury, where, as I have already mentioned, a large proportion of the generation—to the extent, I am authoritatively told, of one-third of the total units—is carried on by water-power. I do not find any allusion to this matter of Salisbury in Mr. Morcom's reply to my criticisms.

With regard to the Leeds and the Newcastle-on-Tyne stations, Mr. Morcom's comparison, as I understand, refers to the figures for the year 1902, when, as I am informed, the Newcastle station was still running largely with reciprocating engines. Consequently, the results are but of small moment in relation to the present controversy.

For the year 1903, whether the figure is Mr. Barker's ·38, or the still lower figure which, as I understand, is now being attained, even if we accept as necessary Mr. Morcom's allowance of 20 per cent. for the difference between units generated and units sold, we shall still have a result which I am sure it will take Leeds all its time to equal, and this with almost the whole Newcastle output generated by turbines. As to this, however, no doubt it will be best to await in patience the publication of the exact figures, which ought now to be available in a few weeks.

In conclusion, I would point out that cost of fuel, labour, and upkeep do not comprise the whole matter. There is also the question of first cost both of the engines and dynamos themselves, and also of the foundations and buildings. Interest on capital expenditure being a very large item in the final result, these latter matters must not be overlooked, and there can be little doubt that in respect to these the turbine has the advantage.

Finally, I would say that after a very considerable and somewhat exceptional experience of several thousands of horse-power of steam turbines, both for electrical and also for other purposes, covering in all a continuous period of some 18 years, I am satisfied that though in the earlier days there were admittedly not a few cases of blade stripping (just as there were many broken crankshafts in the earlier development of high speed reciprocating engines) this is not now a contingency that need be taken seriously into account, given only proper workmanship in the first instance, and reasonable care in running. In fact, under similar conditions in these respects, I have no hesitation in expressing my opinion that the steam turbine is now quite as reliable as any other form of steam engine.

A. A. Campbell Swinton.

66, Victoria Street, Westminster, S.W.
December 14th, 1903.

In the above correspondence the original question, in which results of my tests on the Cambridge plant were compared with those of Prof. Ewing in a manner unfavourable to the latter, is gradually being passed over by the champions of reciprocating engines. I think, before further items are raised, it might be well to settle this.

On the 20th ult. your correspondent said I was *wrong* in my figures respecting the value of vacuum; on the 8th inst. he says "*possibly I am wrong;*" and when I tell you I have authority for saying that "the results of more recent tests on turbines"—than the one on which the table published in the *Min. Proc. Inst. M.E. Glasgow Congress* was based—"show that the curve really bends down, and that the earlier test was based on so small a range of vacuum as not to give the curve accurately; it is always difficult from a small range of tests to determine which way a curve bends," he will do me the justice to say I am right.

I cannot agree that the original point is a fine one; 13 per cent. deterioration in one year's wear, as alleged, needed correction, but I quite agree 1½ per cent. to 2 per cent. increased consumption when a separator is not in use is an extremely fine point. I may, therefore, I think, without undue presumption, assume that the statement by Prof. Ewing on which my share in this correspondence began, namely, "I am of opinion that the results of the present trials show that there has been no deterioration due to wear," has been sustained.

In a letter dated November 20th, my attention is drawn to some tests on Belliss engines referred to in the *Min. Proc. Inst.C.E.*, and on these figures I made some comments in mine of the 30th ult. It appeared to me that not only were the trials incomparable without correction for vacuum in

favour of the original trials, but that a deterioration of 5 per cent. had taken place due to wear. I am anxiously awaiting a reply to this. The value of this correspondence is very small to your readers if statements when started are not fully substantiated or withdrawn; may I appeal to Mr. Morcom to continue this portion of the discussion?

Again, Mr. Swinton and I are accused of *attacking* Mr. Morcom's examples of station results. I fear he forgets he is the attacking party; he began by alleging that turbines are *greatly inferior* to reciprocating engines, whilst we are defending only. I have, as yet, only tried to prove in defence that turbines are on at least an equal footing.

Now to come to the Newcastle-on-Tyne figures, I have not the good fortune to possess a copy of the returns for this station; my figures were obtained from a printed report of the speech of the company's chairman issued by the company, and the figures quoted are for nine months later than two of Mr. Morcom's reciprocating examples, the same year as one and three months earlier than four. Leeds is included in the last four. I think that disposes of the charge of unfairness. The Newcastle-on-Tyne figures are certainly not published in the technical Press, but surely this is not the fault of turbines or a prohibition on their use.

Now, before we go any further, may I be allowed to clear a little ground. I have had some experience in buying and selling engines, and I never remember a case where the guarantees were other than the amount of steam consumed per kilowatt or per horse-power (omitting maintenance for six or twelve months). May we not, therefore, confine ourselves to coal and load factor, at any rate, for the present? I have already pointed out that "stores and oil" and "repairs" include dynamos, mains, batteries, buildings, &c. Even if you placed your valuable space at our disposal, these other figures would require much more time than I have at my disposal to reduce them to the common denominator of turbines and reciprocating engines.

Newcastle-on-Tyne figures are for units *sold*, not generated, if the chairman is to be believed. Page 1 of his speech says, "the number of units *sold* during the year was 5,537,500," which includes wholesale to Wallsend and retail to Newcastle city. Further, on page 2, the number sold retail in Wallsend is given, and the whole of the sales retail are 5,011,300. Before I accept these figures for the reduction to price per unit in coal, may I ask how many units are sold wholesale in Leeds? for I believe all the public lighting is so metered. Even if we take this lower figure of total units sold, the coal still is ·2d. per unit against Leeds ·28, a superiority of 27½ per cent. Mr. Morcom may have later knowledge of Wallsend power house than I, but during 1902 I was in the station almost every week, and the turbine did by far the larger portion of the work. I note the parenthesis *re* the load factor, which reads as though I had wilfully suppressed essential figures. I stated in my last letter against the table that the figure was not available, and even now I do not know what it is.

However, I am prepared to go further in meeting Mr. Morcom, as he objects to Newcastle in my list, and take it out. I must also remove Leeds, and we now have:—

				Coal.	Avge.	Load factor.	Avge.
1901	Newcastle and District		1,619,671	·69		13·67	
1902	Cambridge		419,005	·66	·687	9·13	10·35
1902	Scarborough		431,777	·85		9·34	
1902-3	West Bromwich ...		285,848	·55		9·27	
1902-3	Bootle		1,619,129	·41		28·44	
1902-3	Taunton...		646,273	·70	·77	12·77	16·63
1901-2	Yarmouth		418,021	1·38		9·74	
1901-2	King's Lynn		286,679	·59		15·58	

The result is turbines, average coal ·687 Load factor 10·35
engines, average coal ·77 Load factor 16·63

Now, as to Yarmouth—why may I not "drag" it in? An appeal has been made to the list in the *Electrical Times*, and when I select a town from the same list as nearly comparable to Scarborough as is possible, but to its own disadvantage in load factor, an objection is raised. How, then, can your readers prepare a list for themselves for a few pence if they may not take the figures from the list?

However, to pursue this new argument, which I shall presently show, is two-edged; surely the engineer at Yarmouth is the best judge which coal gives him the cheapest result, and I presume he is of opinion that Welsh will produce more pounds of steam per pennyworth of coal than any other.

On this coal basis, let us take Leeds and Cambridge. Both are using smudge; the railway and cartage rates to the latter town are from a minimum of 8s. 6d. per ton from Nottinghamshire to 9s. 6d. per ton from South Yorkshire. The price paid for coal is, I believe, from 10s. to 11s. (in my time as low as 9s. 9d.)—let us say 10s. 6d. Value of coal is, therefore, 2s.; shall we say 2s. 6d. Leeds, presumably, has a siding, and the carriage rate should not be more than 2s., making smudge 4s. 6d. per ton, and on this basis we have Cambridge coal ·283d. per unit. May I ask now, where is the superiority of Leeds?

Mr. Morcom says he can show 38 stations giving an average of ·41 for fuel, but this is less than a quarter of the reciprocating stations in the list. What about the remainder?

Does Mr. Morcom seriously maintain that he took trouble to make a comparable list, when all of the reciprocating stations he selected are condensing, and two of the turbine stations non-condensing, or only partly so, when the turbine load factor is 10·56 per cent., engine 15·67 per cent., when one of his stations was partly water-driven? I drew his attention to the load factor in my last letter, but I am afraid I cannot follow his reasoning. The total amount of plant in a station has no relation to load factor whatever, and, as far as I know, the maximum reading in all stations is based on the maximum demand made on a station during the year, whether turbine or reciprocating. If the load factor has no close bearing on economy, why should Mr. Morcom accuse me of suppressing Newcastle-on-Tyne? However, I am sure of the support of all station engineers in my view of the value of this figure.

Lastly, Mr. Morcom makes a series of *ex parte* statements regarding turbines, which consideration of your space prevents my replying to. No doubt, he will refer me to the mishap at West Bromwich. In the absence of a reply to this by the builders themselves, I shall be happy to give what I consider a perfectly satisfactory account, as I am conversant with the particulars of this case.

In one paper, Mr. Thomas, of Huddersfield, draws my attention to the record and excellent results obtained in his station. I sincerely congratulate him on it. I would, however, point out that all his units are sold on the switchboard, and at least 25 per cent. must be added to the cost to bring them to units sold, so that, for my purpose, his costs are ·45d. per unit.

I should also like to learn how a station of 2,300 H.P. can be run for 12 months for the sum of £20 (twenty pounds) in oil, waste, water and stores; perhaps Mr. Thomas will give us the benefit of a complete list of his purchases on this head, debiting his stock of stores at the beginning of the year, and crediting those at the end.

John H. Barker, M.Inst.C.E.

Loughborough, *December 14th*, 1903.

I have read with interest the correspondence following on Mr. Wilkinson's paper. As I hope to shortly have an opportunity of dealing with this question at greater length than is possible in a letter, I will not discuss in detail the accuracy of the figures quoted by your correspondents; but as more than one reference has been made to the Wallsend plant of our clients, the Newcastle-upon-Tyne Electric Supply Co., I think it well to point out that the results quoted depend upon such a variety of factors, that in the absence of fuller information, any deductions therefrom are liable to be quite misleading.

As Mr. Lea points out, an attempt is being made, based upon entirely inadequate information, to compare plant working under conditions which differ almost as widely as the machines themselves.

The first of the two 2,000-KW. turbines now working at Wallsend was ordered more than three years ago, and it is sufficient indication of our opinion to say that, as a result of our experience, we have recently placed orders for six Parsons turbines with an aggregate output of over 11,000 KW. for our clients, the Newcastle-upon-Tyne Electric Supply Co. and the Priestman Power Co.

We have also on order for another client a 500-KW. Curtis turbine, which will, we believe, be the first turbine

of this type to operate in a central supply station in this country.

Charles H. Merz.

28, Victoria Street, Westminster,
December 18th, 1903.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Dec. 16th, 1902.		Week ending Dec. 15th, 1903.	
Alexandria	Value £288	Alexandria	Value £310
Amsterdam	586	Amsterdam	60
Auckland	19	Buenos Ayres	105
Bangkok	92	Calcutta	297
Bombay	172	Cape Town	542
,, Teleg. wire	150	Colombo	95
Boulogne	16	Delagoa Bay	31
Calcutta	517	Durban	1,376
Cape Town	274	,, Teleg. mat.	14
Colombo	71	East London	232
Copenhagen. Teleg. cable	260	Fremantle. Elec. machinery	155
Durban	980	,, Teleph. cable	124
East London	1,584	Gibraltar	11
Karachi	315	,, Teleg. mat.	10
Madras	584	Hamburg. Teleph. apprts.	120
Melbourne	467	Melbourne	66
Napier	70	,, Teleg. cable	440
Ostend	377	Montreal	40
Otago	20	Port Elizabeth	40
Perth	1,416	,, Teleg. mat.	62
,, Teleg. mat.	52	Rio Janeiro	76
Port Elizabeth	80	,, Teleg. apprts.	650
Rangoon	26	Shanghai	180
Rockhampton	36	Singapore	141
Sydney	35	Sydney	808
,, Teleg. wire	287	,, Teleg. mat.	230
Teneriffe	552	Wellington	11
Tokio	50		
Vera Cruz	4,523		
Wellington	77		
Yokohama	30		
Total	£14,332	Total	£6,226

Foreign Goods Transhipped.

Perth. Elec. mat.	Value £456	East London. Elec. wire	Value £31
Sydney. Elec. goods	150	Gothenburg. Teleph. mat.	41
Total	£606	Total	£72

Electrical Typewriters.—The Blickensderfer Typewriter Co., of Newcastle-on-Tyne, is placing on the market an electrical typewriter. As its name implies, the motive power—which hitherto has been the physical strength of the operators' fingers—is electricity. At the back of, and embodied in, the machine is a small and constantly-running motor which provides the printing power; the slightest touch of the key is sufficient to make the impression, as the type-wheel is impelled to and from the paper by electrical force the instant the operator's fingers complete the contact by touching the keys. In the construction of present-day typewriters it has been absolutely essential for the moving parts to be made as light as possible in order to reduce the strain on the fingers of the typist; in other words, strength is sacrificed for lightness of touch and easy manipulation, but as the printing power of an electrical typewriter is transferred from the operator to the machine, the manufacturer can now employ mechanism of whatever size, strength and weight may be necessary. Again, no matter how expert a typist may be, it is practically impossible for anyone to avoid striking some of the keys harder than others, as the fulcrums of the rows of levers on the older makes of writing machines are in different positions, and the levers themselves in many cases of different lengths. This irregularity of the striking power creates an absence of uniformity in the imprints, but as the stroke of the machine on an electrical typewriter is always of the same strength, absolute uniformity of the printing is assured. Another advantage of this automatic stroke is the powerful manifolding capacity which is made possible; 15 carbon copies can be produced with the same slight touch of the keys that is required to print a single sheet. Wherever there is an electric installation this machine can be set in operation merely by displacing an ordinary incandescent bulb and inserting a plug which is provided along with the typewriter. The carriage is electrically-controlled, and moves to the right or left at the will of the operator at the touch of a key, while a unique tabulating attachment enables the typist to tabulate the most complicated statements and accounts with accuracy and despatch without removing the fingers from the keyboard. A new ruling device gives a line the entire width or length of the paper in about a tenth the time it takes by the old method of striking the hyphen. The speed with which the mechanism can work is said to be unlimited, and far beyond the power of any operator to acquire.

The Miller Signalling System.—We have received a pamphlet from the British Miller Signal Syndicate, Ltd., describing the Miller signalling system which has already been referred to at length in our columns. The pamphlet contains a technical description of the system with detail drawings. We understand that the system is being favourably received on the Continent, and at the request of some leading British Railways, the company has furnished them with plans and drawings for the proposed equipment of portions of their lines. In the United States, the further equipment of locomotives with the Miller system has been ordered on a large scale by the New York Central Railway.

Catalogues and Lists.—The Sun Electrical Co., of Charing Cross Road, has issued an illustrated list of its various adaptations of the electric reflector specialities, and shop window fittings which we described recently in these columns.

Messrs. Clark, Hunt & Co., 159—160, Shoreditch, E., have issued a catalogue of electric lighting supplies, showing "Venus" incandescent and Nernst lamps, sundry wires, lampholders, switches and so on.

Messrs. B. Kuettner & MacDonell, of 3, Adam Street, Adelphi, W.C., who are the sole agents in Great Britain, for Dr. Jeschke, of Berlin, are sending out a circular drawing attention to the Jeschke commutator protector. They have also sent us a small list giving prices and some details of portable accumulators.

The Electric & Ordnance Accessories Co., Ltd., of Birmingham, has issued a 40 pp. catalogue got up in excellent style, describing its direct working central battery telephone exchange system, and its central battery inter-communication system. The pamphlet should be interesting to all engineers, architects and others who have to do with the equipment of telephonic installations in hospitals, asylums, workhouses and other large buildings. The illustrations, both of the instruments themselves and of the diagrams of connections, are of the first class. Copies of the pamplet may be obtained on application.

The International Electric Co., of Redcross Street, E.C., have brought out a catalogue of their various telephone material including battery call 'phones with and without induction coils, inter-communication sets, magneto call telephones, signalling apparatus for mines, micro-telephones for tramways, central switchboards, &c. Illustrations and prices are given.

Messrs. E. F. Moy, Ltd., have issued a circular of their No. 83 type stage plugs.

The Electrical Co., Ltd., of Charing Cross Road, W.C., has brought out a list illustrating a patent automatic cut-off switch for shop windows, lamp signs, &c.

A new illustrated catalogue has been published by the British Prometheus Co., Ltd., of Kingston-on-Thames, giving very full details of their electric radiators and heating stoves, with diagrams showing how to regulate temperature, also many illustrations of the apparatus, and prices of same.

Some illustrated circulars have come to hand from Messrs. Dorman & Smith, of Salford, in which they give descriptions of their standard electrical accessories. These lists, we understand, have been issued to meet the needs of customers until the next edition of the complete catalogue is ready. The D. & S. grip contact circuit-breakers, chopper switches, tumbler switches, fuses, fuse-boxes and fuse bridges, new patterns of plain iron fittings, and other lines are shown, detailed and priced. There are several new patterns of switchgear shown, notably the automatic circuit-breakers on list A 3, and the "C" type switches on list L 3. The latter are intended to replace some of the older series. We understand that improved methods of manufacture have enabled the firm to materially reduce the prices of many of the older specialities, such as the strong iron fittings, brass ships' fittings, and various porcelain accessories, without reducing the high class of design and workmanship.

Messrs. W. N. Brunton & Son, of Musselburgh, have just issued a new price-list illustrating their special galvanised arc lamp rope, which is of a new construction which renders it very flexible.

Books Received.—"Calculating Scale: a Substitute for the Slide Rule," by W. Knowles. London: E. & F. N. Spon, Ltd.

"Fortschritte der Elektrotechnik," Part IV., 1902, by Dr. Karl Strecker. Berlin: Julius Springer. M. 10.

"Wireless Telegraphy," by C. H. Sewall. London: Crosby Lockwood & Son. 10s. 6d. net.

"Diagrammes et Surfaces Thermodynamiques," by J. W. Gibbs. Paris: C. Naud. F. 2.

"L'Electricité dans les Mines en Europe," by E. Guarini. Brussels: Ramlot Bros. & Sisters. F. 5.

"A Record of the International Fire Exhibition, Earl's Court, London, 1903," by Edwin O. Sachs. London: The British Fire Prevention Committee. 5s. net.

"The Grant and Validity of British Patents for Inventions," by James Roberts. London: John Murray. 1903. 25s. net.

Dissolutions and Liquidations.—On Monday, December 7th, the British Electric Car Co., of Trafford Park, passed a resolution winding-up voluntarily, as the company "cannot by reason of its liabilities continue its business." Mr. T. F. Wild, of 23, Broad Street Avenue, E.C., is the liquidator.

In connection with the transfer of the business to Messrs. Siemens Bros. & Co., Ltd., the British Schuckert Electric Co., Ltd., resolved on November 17th, to wind-up voluntarily, Mr. A. Jacob, the general manager, being appointed liquidator.

A meeting of the Imperial Electric Supplies, Ltd., is to be held on January 15th, at 5, Gray's Inn Square, to hear an account of the winding-up. A meeting of the Pile-Bloc Battery Co. will be held on the same date at the same address for a similar purpose.

Messrs. W. Court and H. Taylor (Court & Taylor, electrical and motor engineers and contractors, 53, Broadway, Wimbledon), have dissolved partnership. Mr. Court, who will continue the business, will attend to debts.

Mr. Stephen Appleyard has retired from the firm of Messrs. Appleyard & Stather, electrical engineers, of 25 and 26, Hopwood Street, Hull. The business will be continued alone by his partner, Mr. Thos. Stather.

Arc and Incandescent Lamp Manufacture.—On Saturday last, at the monthly meeting of the London Association of Foremen Engineers and Draughtsmen, held at the Cannon Street Hotel (Mr. A. W. Hill, the President, in the chair), two papers were read, one being upon "Arc Lamps," by Mr. A. E. Angold, and the second upon the manufacture of electric incandescent lamps as well as a general survey of present and prospective methods of electric lighting, by Mr. J. Harrington. Mr. Angold traced the early history of the arc lamp up to the present time, and gave a detailed account of the new "Maxim" arc lamp, some lamps of this type being exhibited running, and various detached portions placed on view. Dealing with the manufacture of incandescent lamps, Mr. Harrington described the process from the mixing of the cellulose to the stamping of the lamp, samples at its various stages being handed round. By the aid of diagrams the many details in manufacture of an incandescent lamp, as carried out by the Sir Hiram Maxim Electrical and Engineering Co. at their Gillingham Street works, were explained. The author finished with a display of vacuum tubes containing various gases.

The Fire Exhibition.—The British Fire Prevention Committee has issued an official record of the exhibits at the International Fire Exhibition of 1903. We understand that the Committee have only been able to publish this volume through the liberality of the Exhibition directorate; a limited edition of 500 copies will be available to the public through the Committee's agents. We have received a copy of the book for review. It is well bound in red covers, and contains many excellent and interesting plates, as well as illustrations of noteworthy exhibits. The contents make the work a fitting companion to the "Official Record" of the Congress to which we made reference a few weeks ago.

Electric Wiring.—We have received a sample of flexible tubing which has been introduced by Messrs. John Lawman & Co., of 143, New Kent Road, S.E., for the protection of electric light wires from short-circuiting and wire-fusing troubles. The metal tube serves as a protecting mantle without interfering with the flexibility. The tubes are made of steel, either zinc, brass, or copper-plated, polished or unpolished.

For Sale.—Mr. W. E. Bland has resigned the position of managing director of Bland Bros., Ltd., in order to confine himself to consulting work. The company will therefore be wound up voluntarily, and the businesses at Newcastle-on-Tyne and Darlington are now offered for sale. Some details will be found in our advertisements to-day.

Bankruptcy Proceedings.—The creditors of Mr. Max Margowski, financial agent and managing director of the Honduras Government Banking and Trading Co., Ltd., 13 and 14, Abchurch Lane, E.C., met on December 10th at the London Bankruptcy Court before Mr. G. W. Chapman, official receiver. He had been connected with many companies. In 1895 the debtor subscribed £3,500 for working capital of a private syndicate called the Apostoloff Automatic Telephone (Parent) Syndicate, Ltd. He has acted as managing director of the concern, which was reconstructed in 1897 and again in 1903, as the Automatic Telephone Co. (1903), Ltd. The meeting was adjourned to 21st inst. to enable the debtor to submit an offer to the creditors.

At Grimsby on December 10th, Mr. Appleton, barrister, applied for an order to wind up the affairs of Messrs. Sharpe & Co., electrical engineers, of Strand Street, Grimsby. The application was opposed on behalf of the company and the debenture holders. It was stated that a receiver had been appointed, and Judge Sir G. Sherston Baker, in adjourning the application for further evidence, instructed the Receiver not to part with any of the company's effects until after the hearing of the petition.

Trade Announcements.—Mr. C. D. Falcke notifies that owing to pressure of work in his electrical contracting business, he has relinquished his interest in the manufacturing business known as the Birmingham Electrical Fittings Co., and his late partner Mr. Percival West will carry on that business. In the meantime, Mr. Falcke will continue his business of "electrical contracting and personal consulting work" under the name of the Birmingham Installation Co., which was established by him eight years ago. Mr. West notifies that he will carry on the business of his company as formerly, and he intends to greatly increase the plant and machinery so as to be better able to execute orders promptly. It is proposed to remove to much larger quarters, where it will be possible to have a considerably increased turnover.

Messrs. R. W. Vicarey & Co. are about to commence business at 101, Peel Terrace, Marston Road, Stafford, as "experts and analysts of storage batteries and their electrolytes." They have issued a small list explaining their business, giving a tariff of fees.

Mr. Harold Elliot announces that having received an appointment with an electrical firm in Manchester, he has relinquished the agencies for various firms of manufacturers which he has heretofore held at Manchester.

Imports of Foreign Electrical Machinery and Apparatus.—A steady tone is noticeable as regards the imports of foreign electrical machinery into this country, the returns for November showing a total of £37,530 as compared with £37,720 in October last, and bringing up the total for the first 11 months of the year to £505,268. On the other hand, an increase has taken place in the imports of foreign electrical goods and apparatus, November's total being £82,944, as contrasted with £58,212 in the same month a year ago. For the 11 months ending with November the aggregate imports have reached a total of £732,088, an increase of £108,482 over the corresponding period of 1902.

Natal.—There has been a large increase this year in the imports of electrical fittings and telegraph and telephone material into Natal, the returns for the nine months ending with September last showing a total of £86,000, as compared with £48,000 in the corresponding nine months of 1902.

For Sale.—Two Babcock boilers at Blackpool. See our advertisement pages to-day.

A Robertson Lamp Concert.—The employés of the Robertson electric lamp works are holding a concert on Saturday, December 19th, at 7.30 p.m., in the dining hall at the Brook Green works.

Charge of Stealing Cable.—A marine-store dealer and several employés of the Charing Cross and City Electricity Supply Corporation have been up at the Guildhall this week on a charge of being concerned together in stealing copper cable, the property of the above company. Defendants stand remanded.

ELECTRIC LIGHT AND POWER NOTES.

Balmain (N.S.W.).—The D.C. has decided to promote a Bill in Parliament for the lighting of the town by electricity.

Barnstaple.—The T.C. has decided to reduce the price of energy for power from 3d. flat rate to 3d. per unit for ½ H.P., 2½d. for 1 H.P., and 2d. for 2 H.P. and over.

Beckenham.—The U.D.C. has determined to exercise the power conferred upon it by the Crystal Palace and District Electric Lighting Order, 1890, and to require the company to sell to the Council on the terms set out in the Order, so much of the undertaking as is situated in its area.

Belgium.—The Communal Administration of Assche has decided to construct a power station for the lighting of the district, and has come to an arrangement with the Government for the electric lighting of the royal domain and Laeken Park.

Bootle.—The T.C. has resolved to appoint an engineer to inquire into the matter of the order for two additional sets of 600 KW. given some time ago to Messrs. Ferranti, which, it is stated, has not been undertaken satisfactorily.

Bridgnorth.—The Shropshire and Worcestershire Electric Power Co. has given the R.D.C. notice of its intention to apply for a prov. order to supply electricity within the Council's area. The Council, if necessary, will safeguard its interests.

Burslem.—The T.C. has declined to give permission for the Sneyd Colliery Co. to supply energy to Cobridge railway station for lighting purposes.

Cheshire.—The Cheshire Non-County Boroughs Association recently considered the proposed Cheshire Electricity and Power Gas Bill, and resolved unanimously that the various boroughs, members of the association, combine and offer the strongest opposition to the Bill at every stage. A copy of the resolution was sent to the promoters.

Clydebank.—The agreement with the Clyde Valley E.P. Co. as to taking over the powers obtained by the burgh, has been sealed. The company has agreed to pay the Council £400, cost of the order, and for the transfer, £100 per annum for 10 years. At the end of that time, such annual payments shall be subject to a reduction of £2 per annum for each arc lamp, or for every 10 incandescent lamps or their equivalents. The company agree to supply electric energy for public lighting, the Council paying £10 per annum for each arc lamp for street lighting, and £1 12s. for each 16-C.P. incandescent lamp. The Council has power, under the agreement, to resume possession of the order at certain periods on complying with certain conditions.

Colchester.—A new 550-H.P. generating set was started by the Mayoress on 11th inst., the high speed steam engine being supplied by Messrs. Davey, Paxman & Co.

Coventry.—The E.L. Committee has recommended the City Council to borrow a further sum of £31,575 on extensions. The L.G.B. has sanctioned the borrowing of £5,000 for the purchase of electric motors.

Dunfermline.—At a meeting of the T.C. it was stated that a committee had met the secretary of the National Electric Construction Co. in regard to the company's intention to apply for a prov. order for the electric lighting of the area. A clause was inserted giving the company power to transfer the order to the T.C.; but as it did not include Pittencrief Park and Glen, or the area immediately outside the burgh, the committee decided to oppose the application, and recommended the Council to apply for an order. This the Council approved.

Festiniog.—The U.D.C. has resolved to engage an electrical engineer at a salary of £4 per week, to advise it on the alleged breaches of contract with the Yale Electric Power Co., who supply the town. The lighting is regarded as most unsatisfactory.

Germany.—A central electric lighting station is to be established in the town of Meiningen. Water-power is to be utilised.

Glasgow.—A deputation of the T.C. left on Monday last to inspect the systems of street lighting in England in the towns of Leeds, Bradford, Sheffield, Liverpool, Birmingham and London. The deputation includes Mr. Wilson, the gas engineer, and Mr. Chamen, electrical engineer.

The Electricity Committee yesterday recommended that application be made to the Secretary for Scotland for sanction to borrow a further sum of £250,000 in connection with the Electricity Department. Sanction for the borrowing of £1,150,000 has from time to time already been obtained.

Great Marlow.—The U.D.C. has received notice that the Southern District Electricity Co. will not proceed with its application for the lighting of the district.

Huddersfield.—The L.G.B. has sanctioned the borrowing by the T.C. of £7,500 for the purpose of supplying electricity within the U.D. of Linthwaite.

Italy.—Application has been made for an order to utilise the power of the Rivers Vomano and Arno, at Guilianova, for electric lighting purposes.

The Italian Water Conduit Co. is also applying for powers to erect a power plant on the river Ticino for the production of energy for the lighting of Milan and Pavia.

London.—City.—Since the Corporation declined to accept the tender of the Charing Cross Co., for the supply of energy to its area at 3d. per unit, until the City Co., whose price is 8d., had had an opportunity of tendering, the Charing Cross Co. has withdrawn its offer. The Corporation is now in its former position as regards the price and competition.

Bethnal Green.—In a recent report the Electricity Committee of the B.C. states that it has entered into arrangements to purchase the freehold interest of 22 houses in Marian Square, and also the Square itself, as a site for the electricity and dust destructor works.

Shoreditch.—The B.C. has resolved to take up a loan of £7,000 on account of the Haggerston electric lighting extension.

Marylebone.—A committee has been appointed, consisting of the mayor, ex-mayor and the chairman of the Electricity Committee, to confer with the Metropolitan Electric Supply Co., and to report to the Council the terms and conditions on which it would set aside the award.

Loughborough.—The T.C. has resolved to carry out its E.L. order, involving an expenditure of about £28,000.

Lynton.—We have received a contradiction of the paragraph inserted last week stating that the U.D.C. had complained of the supply of energy provided by the E.L. Co. The lighting of the town is stated to be quite satisfactory.

Macclesfield.—The T.C. is negotiating with the British Westinghouse Co. and Messrs. Crompton & Co. relative to an electric lighting scheme for the town under its E.L. order.

New Malden.—The U.D.C. has decided to apply to the B. of T. for a prov. order for the lighting of its area by electricity. The Twickenham and Teddington District Electric Supply Co. is also applying for an order.

Pemberton.—Two new engines of 500 H.P. each, constructed by Messrs. Dick, Kerr & Co., have been put into service. These have been installed to meet the demand for energy for power purposes and for electric traction.

Penrith.—The U.D.C. has adopted an E.L. scheme, necessitating an expenditure of £7,507.

Ramsgate.—The Corporation has resolved to seal the agreement with the Ramsgate and District Electric Supply Co. (Edmundson's) for the lighting of its area, rejecting the proposal of the Isle of Thanet Co.

Redruth.—The T.C. has again resolved to call the attention of the Urban Electric Supply Co. to the unsatisfactory nature of the supply to the town.

St. Annes.—The U.D.C. will shortly apply to the L.G.B. for permission to borrow £4,000, for mains extensions, &c.

Scunthorpe.—The U.D.C. has decided to enter into negotiations with a syndicate with a view to the E.L. order being leased.

Sheffield.—A L.G.B. inquiry was held recently into the application of the T.C. to borrow £10,000, for the purchase of electric motors, to be let out on hire.

Spain.—It is reported that the various electric companies in the Spanish capital are about to combine. The result will be a ompany with a debenture capital of 30,000,000 pesetas and a share apital of 40,000,000 pesetas. It is stated that the fusion is to be brought about with the assistance of English capitalists.

It is proposed to establish a central station at Cullar Baza (Granada) for the electric lighting of that town, as well as a number of small places in the district.

Strabane.—Messrs. Preece & Cardew, the consulting engineers to the Ulster electric power scheme, have intimated to the T.C. that they propose to erect a generating station in its district to supply energy for power within the surrounding area for a radius of 20 miles. For lighting, energy would be supplied to the Council in bulk, if so desired.

Stockton-on-Tees.—With the object of increasing the day load, the T.C. has decided to ascertain from various firms their terms for the hire-purchase of motors.

Stroud.—The R.D.C. has decided to give its consent to the application of the Gloucestershire Electric Power Syndicate for a prov. order for electric lighting in the Council's district.

Trowbridge.—The Western Electric Power Co. will be approached shortly by the T.C. with a view to the company leasing the Council's prov. order for the supply of energy to the area; the T.C. to have the option of purchasing the undertaking after a given time.

Tunstall.—The U.D.C. has received a proposal from the Sir Hiram Maxim Electrical and Engineering Co. for the supply of electricity, under the Council's order, to the district. The Council has resolved not to entertain the proposition.

Watford.—The U.D.C. has resolved to apply to the North Metropolitan Electric Supply Co. to ascertain whether it would be willing to acquire the Council's E.L. undertaking. A public meeting was held to protest against the decision of the Council.

Welshpool.—An interesting installation of electric lighting has been carried out at Powis Castle by Messrs. Drake and Gorham, Ltd.

Whitehaven.—The T.C. has accepted the offer of the Brush Electrical Engineering Co. for electric motors for hiring out purposes.

Widnes.—The T.C. has resolved to apply to the B. of T. for an order to amend its 1901 prov. order, and for an extension of time for the carrying out of the same.

Mr. Thomas L. Miller has been engaged by the Corporation to attend to matters arising in connection with its E.L. Order, and in reference to the supply of electricity in the borough.

Woking.—The T.C. has requested the Woking Electric Supply Co., Ltd., to put down a deposit as security for making good roads, &c. The company has protested against the Council's treatment, but has deposited a sum of money as desired.

Wolverhampton.—The Town Council has decided to extend the electric light mains, at a cost of £913.

Wood Green.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow £43,000 for electricity purposes. This action is stated not to be unanimously supported by the ratepayers, and two members of the Council are opposing, and obtaining information as to an alternative scheme whereby a company undertakes the supply.

ELECTRIC TRACTION NOTES.

Aston Manor.—By desire of the shopkeepers in Aston Road, work on the permanent way will not commence until after Christmas. The Committee has instructed its engineer to advise Mr. Trentham, the contractor, to commence on January 1st, 1904. The poles are being put up, but until the Board of Trade has approved, it is not known whether there will be a double or single line in Park Road. The completion of the line along Lichfield Road is contingent on a new girder bridge being put across the road at Aston Station, L. & N.W. Railway, in place of the present low brick one.

Mr. Robt. Green, consulting engineer to the Council, is about to be appointed arbitrator for the purchase of tramway plant, &c., of the City of Birmingham Tramways Co., Ltd., whose lease expires at December 31st. The Electricity Committee has agreed to supply energy to the Corporation of Birmingham tramways department for the Aston Road route at the rate of 1½d. per unit until 1906, Birmingham paying £200 towards cost of mains.

It will be a matter of regret if double tracks do not receive Board of Trade approval, as it was hoped to get over the present delays which arise with the steam cars on the loop system.

Beckenham.—The B.E.T. Co. has written to the U.D.C. saying that it will on no account consider the question of installing the conduit system here, instead of the proposed trolley.

Birmingham.—The poles for the overhead work on the Aston Road route are up. An agreement has been arrived at with Aston Manor with regard to the latter supplying energy up to 1906. An endeavour is being made to get the Birmingham Tramways Co. to continue their steam car service after the expiry of that company's lease until such time as the Corporation is ready.

The permanent way on the Balsall Heath route has been re-laid, but there is no evidence of the present loop system—the cause of so much delay—being abandoned.

Durham.—The B.E.T. Co., who have a prov. order for the laying of a tramway from Durham to Brandon, have obtained land on which the car shed is to be erected, and negotiations are proceeding for securing the lands necessary for widening the existing roadways. When these are completed an early start will be made with the permanent way.

Folkestone.—The T.C. has, owing to the objections raised to the overhead system, adopted the surface contact system for the electric tramways from the harbour to Cheriton. The estimated cost is £29,000.

Hull.—The Tramways Committee has recommended that 15 cars be fitted with collapsible top covers, the Kennington patent being chosen.

Liverpool Overhead Railway.—A Liverpool paper "has the best authority for stating that the Overhead Railway Co. has entered into a working agreement with the Lancashire and Yorkshire Railway Co., under which the overhead railway will be extended from Seaforth Sands Station, and a physical connection made with the Lancashire and Yorkshire station at Seaforth." The Act for this was obtained in 1900, and negotiations have resulted in this arrangement.

London. — Lambeth. — The B.C. on December 10th, resolved, by 34 votes to 23, to only contribute £20,000 to the cost of the necessary street widenings if the L.C.C. took over and reconstructed the London Southern tramways. At the opening of the meeting a letter was read from the Highways Committee of the L.C.C., stating that it would not recommend the purchase of the undertaking unless the B.C. agreed to a contribution of £40,000.

Mandalay.—An Indian exchange says that the Mandalay tramway will be running by April. The manager is expected to arrive in December.

Newcastle-on-Tyne.—The T.C. on the 3rd inst. considered a report from the Tramways Committee recommending that application be made to the B. of T. for sanction to borrow a further £192,516 for tramway purposes. The matter stood adjourned for consideration.

Paris.—It is stated that the municipality of Paris is shortly to launch another loan of 250 millions of francs—100 millions of which is the contribution of the City to the Metropolitan Railway.

Reading.—The Reading Corporation Tramways Social and Athletic Club, which has been recently formed, had its opening concert and social evening at the tramway depôt on November 30th. Mr. A. H. Bull, the ex-mayor, presided, and among those present were Mr. W. Binns, the engineer and manager, and Mr. A. Shearer, the assistant electrical engineer. Mr. Binns explained the objects, &c., of the club.

Walsall.—Lieut.-Col. Yorke last week held a B. of T. inspection of the new tramways constructed by the Corporation to Walsall Wood, Willenhall, and along the Birmingham Road to the boundary of the borough. The working of the lines will commence at the beginning of the new year, when the Corporation also takes over the tramways within the borough at present let on lease to the South Staffordshire Tramways Co. Altogether, rather more than 12 miles of track will then be under municipal control.

The opening ceremony to celebrate the completion of the tramways extensions and the taking over of the tramways by the Corporation has been fixed for December 31st.

Wolverhampton. — The Tramways Committee has decided "That a six months' trial be given to 100 yards section of a new tramrail being exploited by the Patent Renewable Tramrails Syndicate, upon terms."

Worcester.—In reply to the application of the Tramway Co. for a year's extension of time in which to construct the electric tramways in St. Swithin Street, London Road, and Bath Road, the T.C. has intimated its willingness to consent to a three months' extension only. The work should have been completed by December 17th, 1903.

TELEGRAPH AND TELEPHONE NOTES.

Glasgow Telephones.—The members of this department held their second annual smoking concert in the Masonic Chambers on the evening of Monday, the 14th inst. Mr. A. R. Bennett, general manager, presided over a large company.

Swansea Telephones.—The Corporation Telephones manager reported last week that 466 subscribers' lines had been connected, 252 orders were still in hand, and 94 had been obtained since the opening of the exchange.

A Telephone Social.—The staff of the National Telephone Co., engaged in the Blackburn district, held their third social on the 7th inst., at Taylor's Assembly Rooms, Blackburn. In the unavoidable absence of the district manager, Mr. C. Remington, M.I.E.E., owing to indisposition, the chair was occupied by Mr. W. Lee. An entertaining and varied programme was provided. Supper was subsequently served.

The Pacific Cable.—We have been favoured by the Pacific Cable Board with the following memorandum on the construction and working of the Pacific cable:—

1. The Pacific Cable Act of 1901 was the result of prolonged negotiations between the Home and Colonial Governments and the reports of two special committees presided over by Lord Selbourne (1896) and Sir F. Mowatt (1899) respectively.

2. This Act provided a capital sum of £2,000,000 and appointed the Pacific Cable Board consisting of representatives of the contributing Governments to control the construction and working of the cable.

3. The interests of the Governments concerned are as follows:—

United Kingdom	$\frac{5}{18}$	with three representatives (including chairman, Sir S. Walpole, K.C.B.)
Canada	$\frac{6}{18}$	with two representatives.
Australia	$\frac{3}{18}$	" " "
New Zealand	$\frac{2}{18}$	" one representative.

4. The route was surveyed, and the cable was manufactured by the Telegraph Construction and Maintenance Co., under the direction of Messrs. Clark, Frode & Taylor. The contract was signed on December 31st, 1900, the work was completed in October, 1902, and the cable opened to the public on December 8th, 1902.

5. The route of the cable is from Brisbane (Queensland) and Doubtless Bay (New Zealand) to Norfolk Island and thence *viâ* the Islands of Fiji and Fanning to that of Vancouver (British Columbia). Messages are here handed to the Canadian Pacific Co.'s telegraph system, for transfer to the Atlantic cable companies.

6. Collection and delivery in Australasia are controlled by the Government Post Offices and in the United Kingdom by the General Post Office and Atlantic cable companies.

7. The annual expenses of the board include (in addition to £35,000 for renewals and depreciation) a fixed payment to the National Debt Commissioners of £77,544 18s. in discharge of both capital and interest—a provision which, in the case of an ordinary commercial company, would represent a dividend to its shareholders of nearly 4 per cent. per annum.

8. The advantages derived by the British public from this Imperial undertaking, are as follows:—(1) An alternative route for the forwarding and receipt of messages by the Australasian Colonies, to and from Canada or the United Kingdom; (2) An average service of about 60 minutes between London and Melbourne or Auckland; (3) A reduction per word on through messages amounting in the case of Australia to 1s. 9d., and in the case of New Zealand 2s. 4d. (the difference between the lowest rates previously obtainable for these Colonies and the existing 3s. rate), which on an estimated through traffic of 2,000,000 words represents a saving of not less than £200,000 per annum.

Note.—On the occasion of the Cricket Match between the English and Australian teams at Sydney, New South Wales, in December, 1903, four messages filed in Sydney on November 27th were delivered in London in 12, 8, 9 and 13 minutes respectively, having passed through 210° of longitude at an average speed of upwards of 1,300 miles per minute.

Hugh Latham, *Secretary.*

December 8th, 1903.

The Telegraph Wire Export Trade.—The returns just issued show that the exports of telegraph wire and apparatus connected therewith from this country during November amounted to £145,271, as compared with only £47,065 in the preceding month and £70,900 in November a year ago. Although there was, as will be seen, a slight improvement last month, the year has been a very quiet one in this branch of industry, the aggregate exports during the 11 months ending with November having attained a total of £1,764,899, as contrasted with £2,729,314 in the corresponding 11 months of 1902.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	May 5, 1903	
St. Lucia-Martinique	May 7, 1903	
Anjer-Kalianda	Aug. 2, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 26, 1903	
New York-Hayti	April 13, 1903	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Tourane-Amoy	Nov. 10, 1903	
St. Jacques-Haiphong	Dec. 15, 1903	
Landlines.		
Indo-European between Odessa-Kertsch	Dec. 10, 1903 Dec. 11, 1903	Dec. 10 Dec. 12
Rowno-Odessa	Dec. 14, 1903	

Telephonic Communication with the Continent.—The text of the Convention providing for telephonic communication between the United Kingdom and Belgium has now been published.

The cable is to have four conductors, and the cost is to be equally borne by both countries. Landline systems are to be erected and maintained by each Government concerned, and in a manner as far as possible to avoid induction. The British administration is, however, to maintain the cable, the cost to be borne equally by both administrations.

Special circuits constituted for telephonic correspondence are to be exclusively used for this purpose unless otherwise agreed by both administrations. They are to connect with central offices in communication with public call offices or with offices of subscribers to the telephone service.

A minimum of 3 minutes is to be allowed for conversations. No two correspondents will be permitted to converse more than 6 consecutive minutes should another application be made before or during conversation for the use of the line. Government com-

munications are to have priority. No limit is placed on the duration of Government communications. Charges for a 3 minutes' conversation will be as follows:—4.50 fr. for each conversation originating at or destined for a Belgian telephonic centre, and 5.50 fr. for each conversation originating at or destined for any telephonic centre in England or Scotland which can be connected with a Belgian telephonic centre.

On agreement each administration may establish telephonic relations with another country by means of the lines of the other.

Night conversations may be held under the subscription system; each such conversation may last 6 minutes on payment of half the rates before stated.

Each contracting party reserves to itself the right to totally or partially suspend telephonic service without being liable to any indemnity.

Service regulations to be mutually agreed upon by the two administrations.

After the lapse of one year the convention may be revised at any time at the request of either contracting party.

The Liverpool Chamber of Commerce has received a letter from the Postmaster-General stating that arrangements have been made for telephonic communication between Lancashire and the Continent, and only await legislative sanction in France. As soon as that sanction is given communication by means of the Post Office system will be available between Liverpool on the one hand, and Calais, Chartres, Orleans, and Paris (including the more important suburbs), on the other; and between Manchester on the one hand, and Calais, Chartres, Dieppe, Orleans, Paris (including suburbs), and Rouen on the other. The Postmaster-General regrets to say that telephonic communication is at present impracticable between Liverpool and any other towns on the Continent, it having been found, as a result of an exhaustive series of experiments, that it is limited by electrical conditions to the towns above-mentioned.—*The Times.*

Wireless Telegraphy in France.—In order to have better facilities for trying experiments and for training operators in wireless telegraphy in France, it has been decided to erect two stations in the neighbourhood of Paris. One of these will be near the Pont de Gravelle, and the other, 35 kilometres distant, near Melun. The installation is being erected on behalf of the French postal authorities.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—December 28th. Coal-handling plant for the electricity works. See "Official Notices" December 11th.

Canterbury.—Electric wiring for the Kent and Canterbury Hospital. See "Official Notices" December 11th.

Enniscorthy.—January 20th. Electric lighting and pumping plant (seven sections), for the Lunatic Asylum. See "Official Notices" December 4th.

Erith.—January 18th. Lancashire boilers, piping, condensing plant, three-phase steam alternator of 500 kw., switchboard and cable extensions. See "Official Notices" to-day.

France.—December 28th. The French Post and Telegraph authorities in Paris are inviting tenders until the 28th inst. for the supply of 80 tons of bronze wire, 1,081 tons of copper wire, 250 tons of galvanised iron wire 4 mm., and a quantity of rubber-insulated electric cables. Tenders are to be sent to Le Sous-Secretariat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, whence particulars may be obtained.

Govan.—December 28th. Coal bunkers, conveyor, and electric capstan. See "Official Notices" December 4th.

Hackney.—January 4th, 1904. Feeding and distributing mains. See "Official Notices" December 11th.

Harrismith (Orange River).—January 18th. Cables, transformers, switchgear, &c. See "Official Notices" December 11th.

Irvine.—The Corporation has been inviting offers for laying down plant and working it under its provisional order. J. Dickie, Town Clerk.

Kettering.—January 9th. Electricity meters. See "Official Notices" to-day.

L.C.C.—January 19th, 1904. Six electrically-driven three-throw boiler feed pumps for Greenwich power station. See "Official Notices" November 20th.

Oldham.—December 23rd. Motor and heating appliance hiring. See "Official Notices" December 11th.

Pontypridd.—December 24th. Free wiring tenders; also tramcars. See "Official Notices" December 4th.

Spain. — February 12th. Tenders are being invited by the Spanish Ministry of Public Works for the concession for the construction and working during a period of 60 years of an electric tramway between Porrino and Mondariz (Pontevedra province). Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Obras Publicas, Madrid.

Sydney (N.S.W.).—December 30th. Telegraph, telephone, and electric light material for the Deputy Postmaster-General of Sydney. See this column for November 6th.

Sydney (N.S.W.).—January 12th, 1904. Messrs. Preece and Cardew want tenders for:—One or two 600-kw. or one 1,200-kw. three-phase steam alternators with condenser, pipework, motor-generators, transformers, switchboards, &c., and a coal and ash conveyor. See "Official Notices" December 11th.

Wallasey.—January 16th. Cables, joint and section boxes. See "Official Notices" to-day.

Walthamstow.—January 1st. Permanent way, gas plant, engines, dynamos, batteries, switchboard, cables, overhead equipment, &c., for 11 miles of line. See "Official Notices" December 4th.

CLOSED.

East Ham.—The Committee has received tenders for additional machinery, &c., at the generating station. It recommends that for Section A. (comprising a Musgrave engine and Dick-Kerr generator, &c.) the tender of Messrs. Dick, Kerr & Co., Ltd., at £8,687 be accepted. For Section B. (boilers, &c.) the tender of Messrs. Babcock & Wilcox, Ltd., at £5,080 is recommended.

Gravesend.—The T.C. has accepted the tender of Messrs. H. Balfour & Sons for the supply of a tank for the electricity works, at £178, and that of Mr. G. F. Zimmer for conveyors.

Hamilton.—The Gilbert Arc Lamp Co., Ltd., of Chingford, have been instructed to replace the existing street lighting arc lamps in this town. The work has to be carried out urgently, and is to be completed in about four weeks.

Johannesburg. — The *Light Railway and Tramway Journal* announces that after keen competition the order for the tramway rails, fishplates, and flange rails required by the Corporation of Johannesburg has been secured by Bolckow, Vaughan & Co., Ltd., Middlesbrough. The total quantity required is about seven thousand tons, and the value of the order is over forty thousand pounds. The order for the points and crossings for the same tramways has been secured by Hadfield's Steel Foundry Co., Ltd., Sheffield.

Lowestoft.—The Corporation has ordered four more double-deck cars, equipped with motors and controllers of the Westinghouse 46 and 90 types respectively, from the British Westinghouse Co.

Maidstone.—The T.C. has received the following tenders for the construction and equipment of the tramways from the top of High Street to the borough boundary in Tonbridge Road:—

British Westinghouse Co.	£23,032
Brush Electrical Engineering Co., Ltd.	21,760
Wm. Griffith & Co.	21,635
British Electric Equipment Co.	21,582
Blackwell & Co.	20,079
J. G. White & Co.	19,016
Dick, Kerr & Co. (Recommended for acceptance)	18,871

Swansea.—The Tramways Committee has given the contract for tramways extensions to Messrs. Dick, Kerr & Co., Ltd., at £69,472, a price lower than the amount of their tender, so that British stuff alone should be used. It was found when the cable tenders were considered, that the lowest British offer (£20,000) was £3,000 in excess of a foreign tender. It was thought better to defer a definite decision, to see if the whole of the work could be done by a British firm at the lower figure, and it was thought that Messrs. Dick, Kerr & Co. might be able to make arrangements with Messrs. Callender in this matter, and so admit of the contract being given to one firm.

Walsall.—The following tenders have been accepted by the Tramways Committee:—The British Thomson-Houston Co., Ltd., for motor; Mr. W. E. Rowlands, for portable pit bogie; Messrs. C. Booth & Co., for car body lifting appliance; Messrs. Thwaites Bros., for anvils; Messrs. Joshua Wilkinson & Sons, for swage blocks; and Messrs. Miller & Co., Ltd., for wheel press.

Whitehaven.—The Board of Guardians has accepted the tender of Messrs. Ramsay Bros., of Whitehaven, for wiring the Workhouse for electric light, at £432 10s.

Yarmouth.—The T.C. has accepted the tender of the British Electric Transformer Co. for the supply of additional transformers at the electric light works, at £240; that of Mr. McNaughton for carbons, at £3 18s. 9d. per 1,000 pairs; and that of Messrs. Blake & Knowles for a feed pump, at £67.

FORTHCOMING EVENTS.

Friday, December 18th.—At 8 p.m. Holborn Restaurant (King's Hall). Smoking Concert of the Electro-Harmonic Society, Mr. A. P. Trotter in the chair.

At 7.45 p.m. The Electricals Bohemian Concert at Frascati Restaurant.

Saturday, December 19th.—At 3 p.m. Junior Institution of Engineers. Visit to the Walthamstow U.D.C. Electricity Works.

NOTES.

The Xmas Holidays.—The issue of the ELECTRICAL REVIEW, due on Christmas Day, will appear two days in advance of that date—Wednesday, December 23rd. It is, therefore, imperative that all communications intended for that issue should reach us at the earliest possible moment.

All matter for the editorial department should be in our hands by the first post on *Monday morning next, December 21st.*

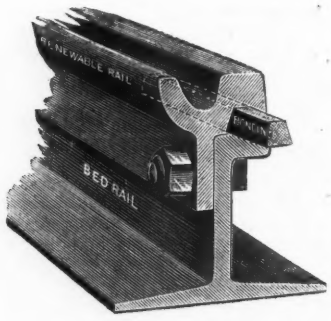
As the advertisement department intimates in an announcement which is made to-day in our other pages—

Saturday morning, December 19th, is the latest time for receiving new copy and alterations for existing displayed advertisements.

Tuesday (noon), December 22nd, is the latest time for accepting "Official Notices" and small prepaid advertisements.

The Bigwood Rail.—If this rail has any advantages over the ordinary girder rail they will be found to arise more from the supported joints than from its renewable characteristic. The rail is illustrated below, and our expert readers can form their own opinions of its merits. The peculiar method of bonding may be dismissed at once as insufficient. The movement of the rail parts will facilitate the access of moisture to the contact surfaces, and will destroy in time the high conductivity essential to good bonding.

Although not shown in the view below, the joints of the "bed-rail" and the renewable rail are not coincident, so that the



THE BIGWOOD RAIL.

ends of the running rail are very well supported by the bed-rail bridging them. On this account, also, the use of fish-plates is stated to be unnecessary.

An experimental length of 200 yards is being laid on the only electrified portion of the City of Birmingham tramways, so after the lapse of time we may be given some practical results, although a trial extending over 15 or 20 years should be necessary, if the supported joint is as good as it looks, before it can be demonstrated satisfactorily that the lessened cost of renewal claimed is not outbalanced by the increased first cost, which is allowed to be heavy, and by the increased cost of maintenance, which is not allowed, but which we fear will be necessary. For the good of "The Patent Renewable Tram-Rail Syndicate," who are working the patent, we hope that our fears may be falsified by results.

Electro-Harmonic Concert.—Mr. A. P. Trotter, electrical adviser to the Board of Trade, will be in the chair at to-night's smoking concert which is to be held in the King's Hall at Holborn Restaurant. Vocal music will be rendered by Mr. Dalton Baker and Mr. Whitworth Mitton. Pianoforte solos will be given by Mr. A. E. Izard, and violin solos by Mr. T. E. Gatehouse, and these two gentlemen, together with Mr. D. Beardwell, will play Gounod's "Ave Maria" (organ, piano and violin). Mr. Will Edwards will be responsible for humorous songs, and Mr. Sivey Levey for humorous sketches.

The secretary of the Society has issued a circular notifying members of the decision of the committee to hold the smoking concerts of to-night and March 25th in the King's Hall instead of in the Crown Room. The remaining concerts of the season will, therefore, be held as follows:—

In the King's Hall:—Smoking concert to-night; ladies' night on February 26th, 1904; smoking concert on March 25th, 1904.

In the Crown Room:—Smoking concert on January 22nd, 1904.

Seventy-eight new members have already been elected during this season, and the committee anticipate that the change abovementioned will result in a further accession of new members.

Presentation.—At the Angerstein Hotel, Westcombe Park, S.E., on Friday last, December 11th, Mr. A. F. Galpin was presented with a purse of gold on the occasion of his leaving the service of Messrs. Johnson & Phillips, of Old Charlton, with whom he had been for 14½ years in their dynamo department. Councillor E. A. Brandon made the presentation on behalf of the subscribers, who numbered over 100, and Mr. Wm. Rowland, who was previously for several years in charge of Messrs. Johnson & Phillips's test room, testified to the able manner in which Mr. Galpin had carried out his duties, and to the good feeling which existed between him and the various members of the staff.

London County Council.—At the meeting on Tuesday the Council decided to sanction the borrowing by the St. Pancras Council of £5,764 for street arc lamps and columns.

The Main Drainage Committee referred to the tenders received for the supply of electrical plant and fittings for the Abbey Mills pumping station. Having given the question further consideration, the Committee expressed the opinion that the work of providing an electric lighting installation at that station should be postponed for some time, and they therefore did not propose to submit a report on the tenders at present.

The electric lighting of the Horniman Museum was mentioned by the Historical Records Committee, who reminded the Council that the engineer had anticipated an annual saving of £140 in the cost of energy by making certain alterations in the installation. A year had elapsed since the completion of the work, and it was found that the economy actually realised, amounted to £143.

The Highways Committee, in reporting on the proposed acquisition of the undertaking of the London Southern Tramways Co., stated that the Camberwell Borough Council had consented to certain doublings, and to the use of the overhead-trolley system on short portions of the lines within that borough. In the case of the Lambeth Borough Council, a conference had taken place, and the chairman of the Highways Committee made it clear that the matter could not proceed except on the terms of a one-third contribution by Lambeth, and the approval of the overhead method on the lines from Clapham Road to Camberwell Green and Norwood respectively, while the South Lambeth Road section would be equipped on the conduit system. The Borough Council has not yet agreed to make such a contribution, and the Committee had unanimously decided that they could not recommend the Council to purchase the undertaking unless the Borough Council accepted the proposals put forward.

The Council postponed for a week the consideration of a report in reference to the early conversion of the Brixton cable line to electric traction on the conduit system. It is proposed to proceed with the work as rapidly as possible early in the new year, and it is hoped to have the lines ready for electrical working before the commencement of the heavy summer traffic. The roadwork is estimated to cost £90,000 and the rails £17,300.

New College Magazine.—With pleasure we welcome the appearance of the first number of *The Central*, a magazine which is being issued by the Central Technical College Old Students' Association. Up to this time the Old Students have been content with the *Central Gazette*, the monthly journal of the—shall we say Young or New?—Students; but the need of a more ambitious and appropriate organ has long been felt, and has now been met in a manner worthy of the occasion. *The Central* is an exceedingly meritorious production; it is edited by Dr. E. F. Armstrong (hon. sec.), and Mr. M. Solomon, and opens auspiciously with an excellent portrait of the President of the Association, Prof. W. C. Unwin. The principal articles comprise a well-illustrated description of the new electrical laboratories at the C.T.C., which are presided over by Prof. W. E. Ayrton, F.R.S., and for the design of which Mr. T. Mather, F.R.S., and Mr. W. Cramp are mainly responsible; an editorial article on Mr Duddell's "Oscillographs," which were first designed and made by him at the C.T.C.; a review of Prof. Armstrong's educational essays; and a variety of notes relating to past and present students and their work. If, as we doubt not, succeeding issues are of equal merit with the first, we may congratulate *The Central* on its position in the foremost rank of college magazines.

The "Poor Man's Light."—The following letter, received from one of our Indian fellow-subjects by a London firm, is not without interest:—

"Gentlemen,—I should feel much obliged if you would kindly furnish me with your illustrated catalogue for electric lights, informing me at the same time if your firm can supply me with electric lights made of *carbon sticks* similar to those now used on railway engines in the United States, which burn continuously from 8 to 10 hours, throw light up to the distance of about a mile, and do not cost more than ½d. each.

"The favour of an early reply is requested.

"Yours faithfully, &c."

Whether the "lights," the carbon sticks, the railway engines or the United States, burn so long and so effectively, the cost is distinctly moderate.

Royal Institution.—The following are among the lecture arrangements at the Royal Institution before Easter:—Prof. H. L. Callendar, three lectures on "Electrical Methods of Measuring Temperature"; six lectures by the Right Hon. Lord Rayleigh on "Physics." During the season 1904, the lectures on Tuesdays and Thursdays will be delivered at five o'clock, and the Saturday lectures at three o'clock. The Friday evening meetings will begin on January 15th, when a discourse will be delivered by the Right Hon. Lord Rayleigh on "Shadows;" succeeding discourses will probably be given by Mr. Alexander Siemens, Prof. F. T. Trouton, Prof. Dewar and other gentlemen.

(*Continued on page* 996.)

RECENT EXTENSIONS OF THE BRADFORD CORPORATION ELECTRICAL UNDERTAKINGS.

It is conceivable that the advocates of municipal trading would regard the City of Bradford as an excellent example of the application of the principles which they uphold, for the municipality controls the gas, water and electricity supply, markets, libraries, art galleries, baths, parks, sewerage, refuse destructors, tramways, a technical college, and a conditioning (or testing) house. Certainly this is ample evidence, not only of the progressive character of the city, but also of the success which has attended the Corporation's efforts in a direction which, at the present time, meets with the keenest criticism.

It is, perhaps, invidious to select any one of these departments for special commendation, but, in view of the prominent position which Bradford has always occupied in the electric supply world, and particularly in view of the great developments which have taken place during the last few years, the electricity department is specially deserving of notice.

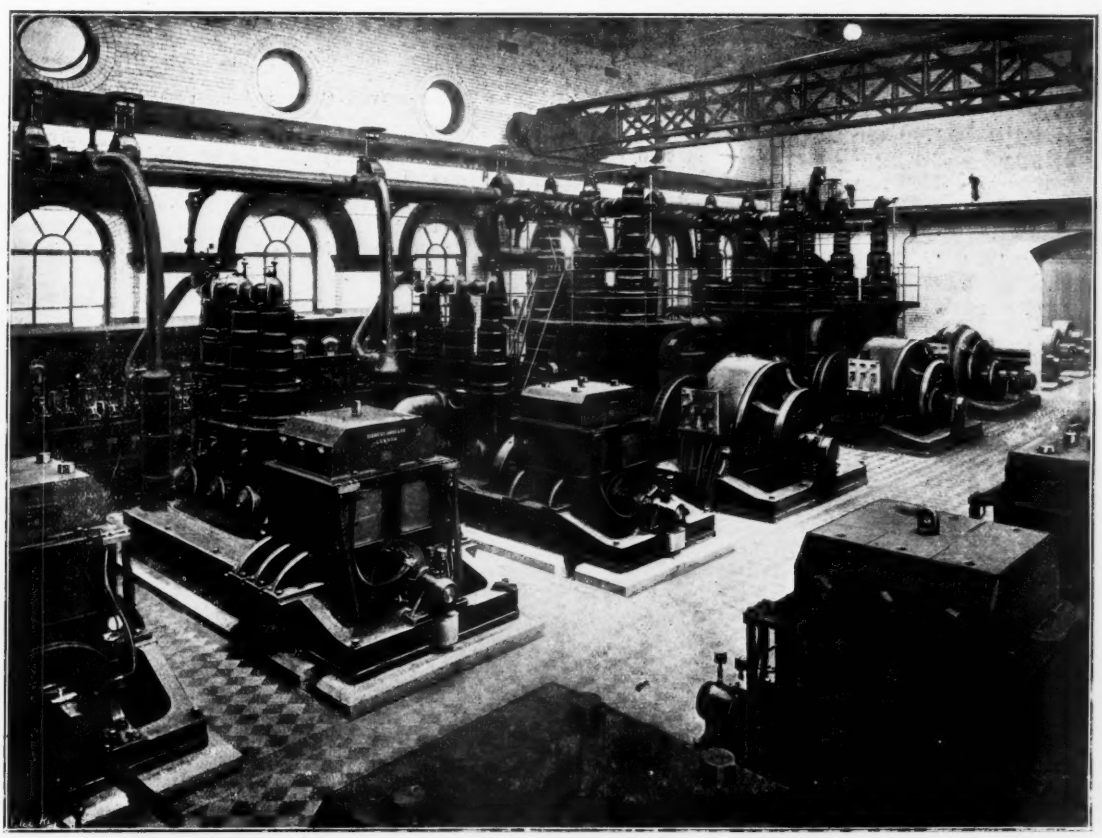
The Bradford Corporation was the first public body in the kingdom to adopt electricity as an illuminant. In the year 1883 it obtained a provisional order to supply electricity within the borough, and subsequently, in 1889, commenced the original supply from the Bolton Road works. The capital outlay was £20,000, and the system adopted was the two-wire direct-current system, Mr. James Shoolbred being the consulting engineer for this original venture, while Mr. Sydney W. Baynes was the first borough electrical engineer.

Some 10 miles of cable were laid by Messrs. Siemens, and at the end of the year 1889 some 4,689 8-c.p. lamps were connected, and 82,500 units had been sold. It is interesting to compare these figures with the last official returns, which show equivalent lamp connections amounting to 239,509, and units sold as 9,124,223 ; this latter figure including 5,259,202 traction and 1,900,034 private motive power units.

The year 1892 saw the first motors connected to the system, amounting to about 20 h.p., and this desirable class of consumer received a great stimulus in 1897, when the Corporation adopted Mr. A. H. Gibbings's original proposals for a scheme for hiring out motors ; an arrangement which has since been copied by numerous supply authorities with conspicuous success.

That the arrangement has met with due appreciation in Bradford will be gathered from the fact that at the end of 1902 some 641 motors were on hire out of a total of 913 motors, representing 4,398 h.p. connected. The latter figure has since grown to nearly 5,000 h.p., which constitutes a record for electricity undertakings in Great Britain.

The first station (No. 1) erected at Bolton Road had a total capacity of 850 h.p. The generating plant consisted of two 150-h.p. and two 200-h.p. Willans-Siemens sets, with compound two-crank engines, and one 150-h.p. Marshall-



View of Engine Room and Traction Switchboard, Valley Road (No. 2) Station.

Siemens set, the engine for which was of the compound marine type, the voltages of the machines varying from 250 to 325 ; steam was supplied from four Lancashire boilers 7 ft. diameter and 28 ft. long, in conjunction with which a Green's economiser of 240 tubes was installed.

The original storage battery consisting of 70 cells of 1,000 ampere-hours' capacity was situated here, but owing to the rapid development of the undertaking, this has been superseded by two large batteries, each consisting of 135 cells, of the Electrical Power Storage Co.'s KLP type, and having a capacity of 2,400 ampere-hours.

In conjunction with these batteries a 100-kw. balancer coupled to two 30-kw. boosters has been installed ; it was built by the Phœnix Dynamo Manufacturing Co., of Bradford. The boosters are designed for a normal output of 300 amps. at any voltage from 10 to 100, the balancers being capable of dealing with an out-of-balance current of 300 amps. at 230 volts, the normal speed being 600 r.p.m. This balancer-booster set is stated to be the largest at present erected in the kingdom.

F

The switchboards for controlling this set, and the two regulating boards, on either side of it, each having forty ways, both charge and discharge, were also constructed by the Phœnix Co.

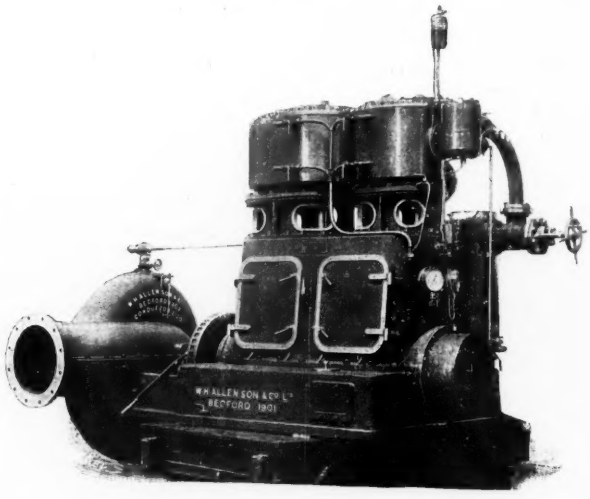
The stores, meter and motor testing and mains departments are located at the Bolton Road station, which is now used principally as a stand-by to the more recently built stations described herewith.

In the year 1895 it was realised that the Bolton Road station was totally inadequate for the needs of the supply area, and Mr. Alf. H. Gibbings, the electrical engineer's recommendation to build a new station on a less restricted site in Valley Road was adopted. This station (No. 2) was opened in 1897, a description appearing in the Electrical Review of November 26th of that year. In 1900-1 considerable extensions were made to it by the addition of a boiler house, economiser and brick chimney, the latter to replace the original iron chimneys, also workshops, cooling towers and coal storage; this work was carried out by Mr. R. A. Chattock, the late electrical engineer.

The station now contains 14 Willans high speed engines, 12 being of the three-crank triple-expansion type, with a total horse-power of 6,500. Six 300-H.P. engines are coupled to Siemens bipolar generators, having an output of 700 amperes at 220—250 volts, with a speed of 350 r.p.m. These machines are used as steam balancers on the lighting network.

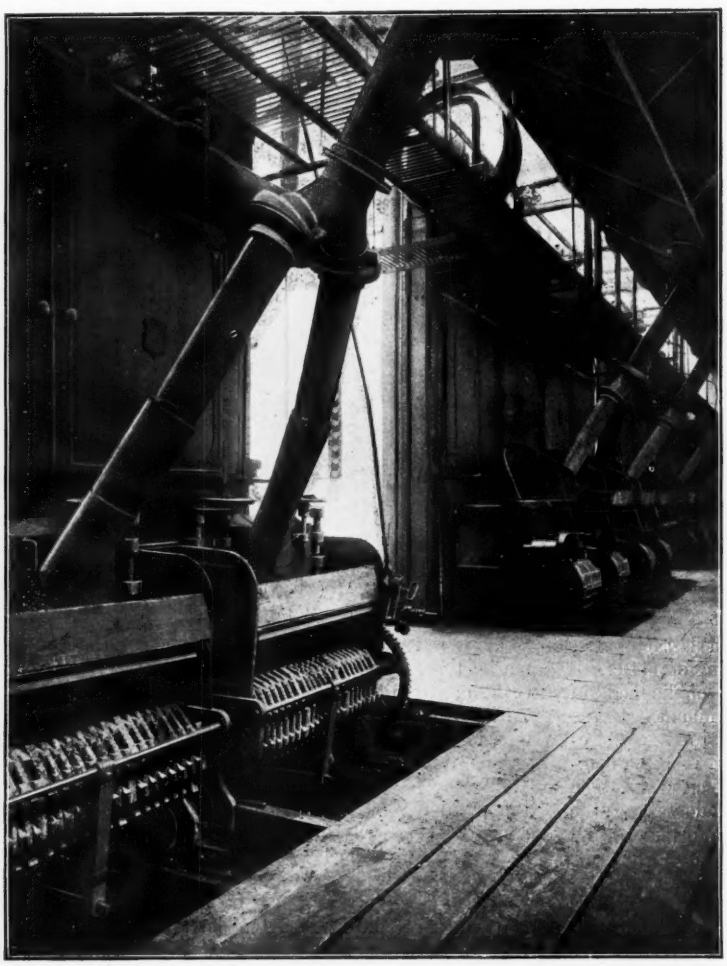
Four engines of 700 H.P. are coupled to Siemens six-pole compound-wound generators, running at 300 r.p.m., and having an output of 750 amperes at 500—550 volts for tramway work; they can also be run across the outers of the lighting network as shunt machines at 460 volts.

Two similar 700-H.P. engines, added at a later date, are coupled to generators of the Electric Construction Co.'s make, of similar output. By their addition, the whole of the available space in the engine room was occupied, but in order to cope with the increasing load, two additional 300-H.P. Willans three-crank compound engines, coupled to Bruce Peebles multipolar generators, were installed in the extension building, intended for a workshop, and situated at the end of the engine room. These machines have an output of 400 amperes when running at 350 r.p.m., and can be utilised either for lighting or traction purposes.



20-in. Steam-driven Centrifugal Circulating Pump, Valley Road Station.

A 12-ton hand-operated travelling crane runs the length of the engine room.



Extension Boiler House, Valley Road Station.

In the extension building is also installed a motor-generator of 100 KW. capacity, built by the Phœnix Dynamo Manufacturing Co.; this is for the purpose of supplying energy to the tramways department at night time for shunting and car-shed lighting.

The motor is run off the lighting busbars, the generator supplying energy at traction voltage. By using this machine, it is only necessary to run one steam generator on both lighting and traction for the night load.

The engines exhaust into a 20-in. main exhaust pipe in the basement, having at one end an outlet to atmosphere fitted with an automatic valve.

Connected to the main exhaust are three surface condensers of Messrs. Cole, Marchent & Morley's make; each is capable of dealing with 30,000 lbs. of steam per hour at 200° F. The first one installed in the basement, at the extreme end of the main exhaust pipe, was fitted with motor-driven air pumps, the latter driven through spur gearing. The two later additions were installed in the basement between the larger generating sets, and on opposite sides of the main exhaust. The air pumps for these condensers are situated in the extension building, and are of Messrs. Cole, Marchent & Morley's standard steam-driven pattern, fitted with 12-in. diameter Edwards air pumps.

The circulating water for these condensers is supplied by two 20-in. diameter centrifugal pumps, each driven direct by a two-crank compound high-speed engine. Both pumps and engines were supplied by Messrs. W. H. Allen, Son & Co. Each pump is capable of delivering 7,500 gallons per minute against a head of 50 ft., when running at 365 revolutions.

This pumping plant is situated in the extension buildings, and draws water from a reservoir at the rear of the works, returning it through the condensers and to the top of a Klein cooling tower erected over the reservoir.

The cooling tower is operated by eight fans, driven from four 40-H.P. Phœnix motors, and is capable of dealing with the circulating water required for condensing 100,000 lbs. of steam per hour.

The original boiler house at this station is equipped with six marine type boilers supplied by Messrs. John Brown and Co., Ltd., and one Babcock water-tube boiler.

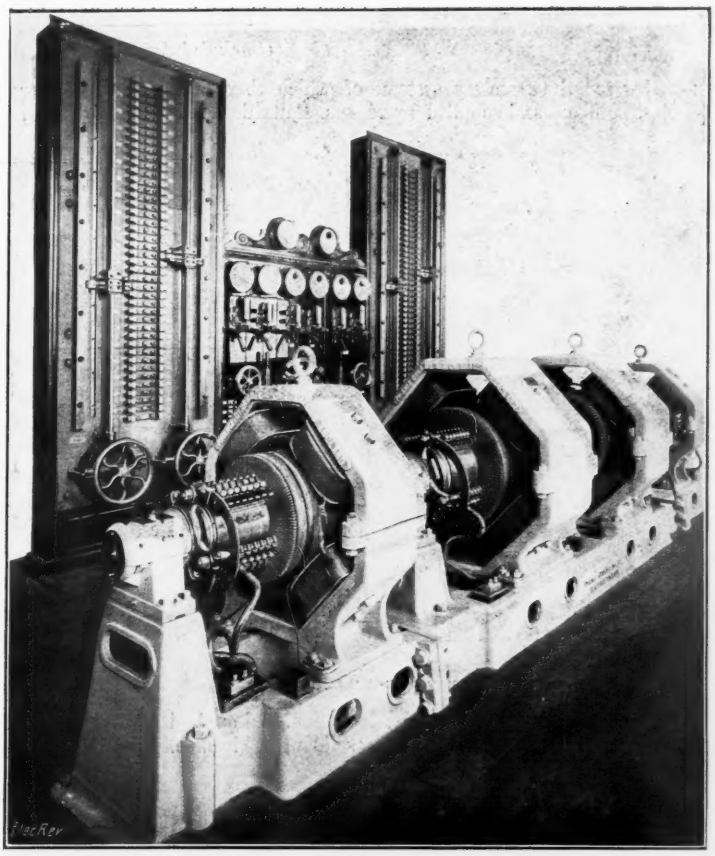
The marine boilers are equipped with the Ellis-Eaves induced draught system, each boiler being fitted with a fan 7 ft. 6 in. diameter, coupled to a 20-B.H.P. Scott and Mountain motor; and the products of combustion are discharged through three iron chimneys of about 60 ft. in height.

These boilers are hand-fired, and designed to evaporate 10,000 lbs. water per hour, but can, when forced, do much more. The Babcock boiler is capable of evaporating 12,000 lbs. of water per hour, and a further five boilers, by the same makers, which are installed in the new extension boiler house, are each rated to evaporate 15,000 lbs. of water per hour.

The Babcock boilers are fitted with chain grate stokers, driven from a countershaft by an 8-H.P. motor, also superheaters of Messrs. Babcock's pattern.

Coal bunkers are provided, facing the marine boilers and overhead in the new boiler house. The latter bunker is provided with an elevator and band conveyor for handling the coal, which falls by gravity into the stoker hoppers, through spouts. This apparatus was supplied by Messrs. E. Newell & Co., of Gainsborough.

The ashes from all the boilers are fed through hoppers into trucks running in a subway under the stoking floors, the trucks being raised by means of a lift at the end of the building, to a tipping platform, for filling carts.



Balancer-booster Set and Battery Regulating Board, Bolton Road Station.

View of Marine Boiler House, Valley Road (No. 2) Station.

The flue gases pass through a Green's economiser, containing 864 tubes, to a brick chimney, 10 ft. 6 in. internal diameter, and 205 ft. high, which it is intended shall replace the iron chimneys at present used for the marine boilers.

In connection with the boiler house there is installed two Weir feed pumps, each having a capacity of 5,000 gallons per hour, these are situated adjacent to the extension boiler house; two electrically-driven feed pumps by Messrs. Scott & Mountain, of Newcastle, and Messrs. Smith, Bros. and Eastwood, of Bradford, and a Pearn steam pump were installed in connection with the original marine boilers. The feed water is drawn from storage tanks situated over the economisers and in the older boiler house, the water being obtained from the town supply.

Duplicate 4-in. feed mains are provided by means of which the pumps can feed either direct or through the economiser to the boilers.

A 10-in. main steam ring runs round the engine room and over the marine boilers, a similar sized branch running at the back of the recently added water-tube boilers. The boiler branches are fitted with non-return and stop valves.

The switchboards in this station, which control the whole of the lighting and tramway circuits in the city, will be described in connection with the later extensions in our next issue.

(To be continued.)

DURBAN (S. AFRICA) ELECTRIC LIGHT AND TRAMWAYS.

From a Special Correspondent at Durban.

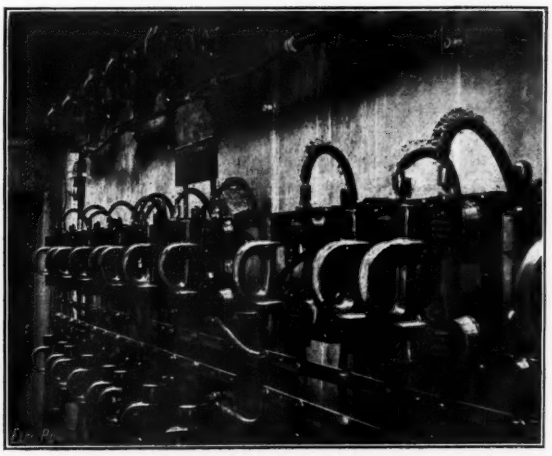
(*Concluded from page* 955.)

The mains for the tramway system, of which there are 17¼ miles, were laid and supplied by Messrs. Callender, and

View of Durban Sub-station.

are of the V.B. make ·2 and ·3 sq. in. in section, and are laid mostly in wooden troughing filled in solid with bitumen.

19/14 feeders are taken through switches up the pole to the trolley lines, where they are divided by section insulators, so

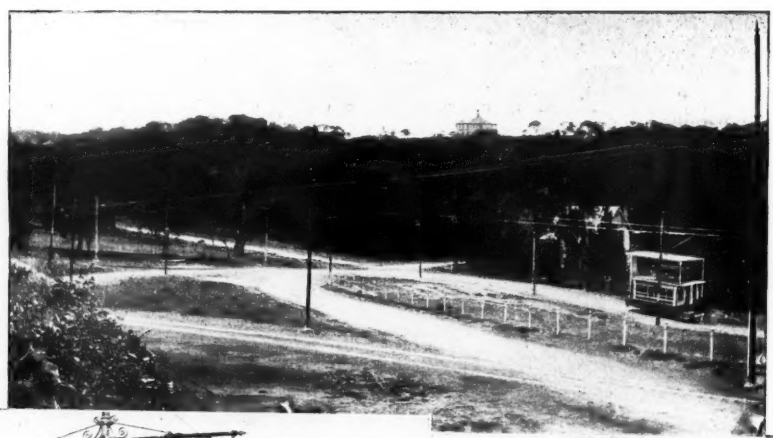


L.T. Switchboard in Main Sub-station.

that sections can be readily isolated from each other or put in parallel.

The trolley line is practically doubled throughout, and is

"Horse Shoe" Curve at Mitchell Park.



Durban Sprinkler.

Overhead Construction and Car on Track.

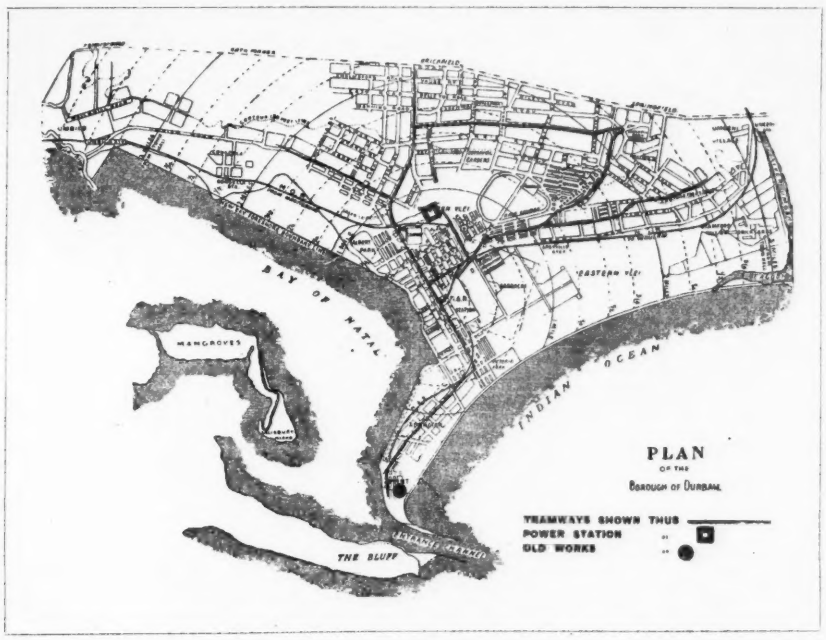
These cables radiate from the power station to the various street boxes, of which there are 13 in number, from which

of No. 00 B & S. gauge, double insulated in all cases, and supported from centre double bracket poles in the town

proper, and from side poles with span wires in the residential portion of the town, there are also a few places with single-bracket poles; there are various kinds of suspension, mostly of the flexible construction, carrying the trolley wire at an average height of 21 ft. 6 in. above the ground. A negative booster cable is also laid from the centre of the Berea circle, but as yet this has not been put into use.

The poles are lap-welded steel, tapering from 7 to 5 in., generally 32 ft. long, except in some cases where 38-ft. side poles are used, the extra height being to carry the overhead telephone and electric light wires, and are bedded in about 6 ft. of concrete. The centre poles have ornamental bases, and stand on islands with granite setts. The gauge of the track is 4 ft. 8½ in.; the rails are of the girder section, weighing 87 lbs. per yard, and in 60 ft. lengths, laid on a concrete foundation.

At present there are 5·88 miles of streets with double track, and 5 miles of single track, including sidings, and on two routes, where the old rails are being used for the time, there are 1½ miles of double and ·8 mile of single track to be relaid. The points and crossings were supplied by the Lorain Co., and are of manganese cast-steel.



Map of Durban Tramway Routes.

The type of bond used is the "flexible protected" under the fish-plates; cross-bonding is effected about every 120 ft. on single track, and on double tracks all four rails are bonded about every 240 ft. Sidings are arranged at various places for special cars, and convenient stopping places are arranged for, the poles being distinctively painted. The track is paved throughout with Jarrah blocks set in cement, and the streets are admirably suitable for electric traction, being in many cases 100 ft. wide, and lined with trees in the Berea; the side poles are in no way an eyesore.

Generally, the town proper is fairly level, and its streets fairly straight; the sharpest curve has a radius of 79 ft. from the centre of the track. On the Berea a good portion is hilly, the average gradient being about 1 in 20 ft., and the sharpest curve has a radius of 80 ft., combined with which the gradient is about 1 in 50 ft. This is at Mitchell Park, where the old trams had to reverse horses to take the "fork" in the road. This has now been laid out in the form of a horse-shoe, and is clearly shown in one of the illustrations. A special check-rail has been laid at this curve.

To meet the large demand for motive power some 6¼ miles of special motor mains have been laid in various places in town for a 500-volt D.C. supply with switch boxes, which are interconnected to the traction switch boxes, thus practically duplicating the town portion, the rails being also used as the return; where motor mains are laid in streets off the tram routes, a bare copper return has also been laid connected with the nearest rail. Motors up to 5 H.P. may be taken off the alternating supply, but such demand has practically given way to the continuous current supply. The motor mains are also made use of for the street arc lighting; the cables for the various circuits are taken from the nearest switch box up the traction pole, where they are connected to the bare overhead mains (of No. 6 B.W.G.); there are about 6 miles of streets so lighted by 155 lamps, in addition to 35 Brockie-Pell lamps which are still running from the old works, but which will all be changed over very shortly. The overhead arc mains are run from pole to pole, supported on shackle porcelain insulators over the centre of the tracks, with a lamp on every alternate pole in the town; the lamps were supplied by the American General Electric Co., and are of the enclosed type, with clear inner and opal outer globes.

They are arranged in groups of five in series, a resistance being inserted between the last lamp and the rail connection for the return circuit. They are provided with an automatic resistance, which is brought into play if, for any reason, the lamp fails, thus preventing any abnormal rise in pressure on the remaining lamps.

Fuses and lightning arresters are provided in the switch boxes for each of the circuits. Lightning arresters are also arranged direct to the trolley lines, which are fitted at each section pole, the iron of the bracket arm forming a core for the coil which is wound thereon.

There is only one guard wire, and that is run over the centre of the tracks, about 1 ft. above the arc mains and 2 ft. above the trolley lines, which wire is securely terminated at each pole, and so far it has proved very effective; the double guard wire over each trolley wire, as at first arranged, proved to lose its advantage by becoming a source of inconvenience by breaking from various causes.

There are 46 cars in use at present, also two road sprinklers and two stone trucks.

The cars are of the double-decker type, with canopy; the length of the body is 15 ft. 9 in. by 8 ft. (inside dimensions), and the height between the lower and upper decks is 6 ft. 7 in. The trucks are of the Brill type, and the length of wheel base is 7 ft. There are four wheels with a diameter at the tread of 33 in.

An American "Providence" life fender is fitted to each car. The style of car is partly open to suit the climate, with a glazed door at both ends; the windows are provided with spring roller blinds, and the seats are arranged transversely with a passage way in the centre, and accommodation is provided for 20 persons inside and 30 persons outside. The floor of the car has double trap doors, allowing easy access to the two motors, which are of the G.E. 58 pattern of 25 H.P. each. The lighting of the cars is arranged in two circuits of five lamps in series, and there is an illuminated interchangeable destination board and head light.

The type of trolley used is the "straight under-running" fixed on the roof of the top canopy.

The motors are controlled by series parallel controllers of B 13 type, and emergency switches are fixed under both the motorman and conductor's canopy. An electric emergency brake is provided in addition to the usual hand brake, and a lightning arrester and circuit-breaker are also provided for each car.

There is a 5-minute service in town and 10-minute to the Berea during the daytime, and after 7 p.m. there is a 10-minute and 15-minute service respectively up to 11 p.m.

The mains for the lighting system are of various makes and classes; up to the present about 39 miles of H.T. mains have been laid, mostly of the B.I.W. and Callender V B. class, laid in wooden troughing with bitumen, while

some are of the lead-covered and armoured type, laid under a tarred plank. They are practically duplicated everywhere, and on the Berea are so arranged as to form one long ring main with sub-ring mains, which can be split up into sections as required from the various street boxes or sub-stations. There are altogether 14 mains leaving the station, mostly of 19/16 size. The sub-stations, which are 10 in number, are built in some cases above, and in other cases below ground, of very neat design, and roomy. The sub-station transformers are mostly of the American General Electric Co.'s oil type, of 30 KW., convertible to either 100 or 200 volts. The H.T. mains are brought into Bates switch fuses, and the L.T. board is of the "Brush" open type, as shown in one of the illustrations; this was taken from the main sub-station, which has also a H.T. board of the well-known Ferranti pattern. The Berea transformer pillars, which are 17 in number with combined H. and L.T. switch boxes, are all above ground and placed on the kerb line; the transformers are of the Electric Construction Co.'s make, of 20 KW., and are also convertible to either 100 or 200 volts. The switch-boxes are divided into two compartments with H. and L.T. sides operated from either side. The fuses are of the Bates pattern, each properly enclosed in a slate compartment. Each sub-station feeds on to its own particular L.T. network, only the transformers in any one sub-station being in parallel with each other, while on the Berea the districts fed from each transformer are also isolated from each other. The use of bare overhead L.T. mains is a great feature here. Permission to adopt similar means would be very welcome to English central station engineers where the consumers are scattered over a large area. As previously mentioned, extra long traction poles have been used on some of the Berea routes to carry lighting and telephone wires. The lighting mains radiate from the various cross-roads where the transformers feeding that district are fixed, and are mostly of 19/17 size, carried on porcelain insulators fixed to strong cross-arms near the tops of the poles, from whence the house services of No. 10 weatherproof wire are led off to the roof through a porcelain "flying fuse." The house mains are led through insulated tubes to meet the supply mains on the roof, and run to the meter board, which carries also a main switch and fuses. In other places 25 and 30 ft. poles are used, sometimes on both sides of the road, and generally on the kerb line.

The overhead mains are fed by armoured concentric cables taken up a special feed pole placed near the transformer. Lightning arresters are fixed where each feed cable joins the overhead mains, as well as on other prominent parts of the line, and, in addition to this, a guard wire, properly "earthed" at places, is run about 1 ft. above the mains, secured at every pole, thus "earthing" each, and also serving a very useful purpose against lightning storms, which are very frequent here, besides warding off falling wires.

So far the system has been very fortunate, only two transformers being damaged by lightning; and with such a large network of some 46 miles of streets with overhead mains, this speaks well for the efficacy of the precautions taken.

The principal roads on the Berea are lighted by arc lamps also, in this case suspended from the span wires close to the poles; in other cases incandescent lamps are suspended from the span-wire in a special water-tight fitting. A special switch-wire is run for the control of these from any desired point. The mains in the side streets are of No. 6 B.W.G. Such streets are lighted by incandescent lamps fixed on brackets to the poles, the total number of incandescent lamps used for street lighting up to date being 682.

Shackle insulators are used very freely on the lines, so that the load can be easily transferred from one district to another, in the event of the transformer feeding that particular district becoming overloaded, by either cutting or joining through the connecting "jumper;" it is the intention to fix switches near the top of the poles, by which these shackles can be connected through when any rapid changes are needed. There are 22 miles of L.T. mains laid underground in town, there being practically none overhead for private supply; these mains are generally laid on both sides of the streets, and the feeders from the sub-stations are 37/14 size, mostly lead-sheathed and double armour protected, with both rubber and fibre insulation. The house services are joined through a Callender box, which is filled up solid with compound and led into a meter board containing meter, fuses, and switch. The meters are of various makes, but generally of the American General Electric Co.'s induction type.

The wiring is under the supervision of a wiring inspector; the standard of insulation required is 25 megohms per point for 100 volts and 50 megohms per point for 200 volts. The demand for light and power is still very great, and the past month has exercised a large staff, no fewer than 139 new connections having been made, which is a record few towns in the world of this size can boast of after six years running. The charge for lighting is 8d. per unit flat rate, and for motive power 2d. per unit, in addition to a standing charge of £5 per H.P. per annum; this rate is the cheapest of any South African municipal supply, and will at no distant date be reduced to 6d. per unit. The tram fares are 2d. for the first two miles by cash, or 1½d. by books of tickets. The traction plant was supplied and erected by Messrs. Dick, Kerr & Co., and the cars and overhead equipment by Messrs. Macartney, McElroy & Co.

With regard to the financial position of the undertaking, the amount spent has been £190,461, and the number of KW. installed is 2,850, which brings out the capital expenditure per KW. at nearly £67.

The amount set aside in reserve since the start has been £24,400, and the total profit handed over towards the relief of the rates has been £18,726.

The borough engineer is Mr. J. Fletcher, and the tramway manager Mr. W. D. Jeffs. As before mentioned, Mr. J. Roberts is the borough electrical engineer, with Messrs. A. G. H. Taylor and G. Poole as assistants, and it is to the latter that we are indebted for this article and the accompanying photographs.

NOTES.

(*Continued from page* 990.)

The Nobel Prizes.—The following are amongst the winners of the Nobel prizes awarded by Swedish institutions:—For physics, Prof. Henri Becquerel, of Paris, divided with M. and Mme. Curie, of Paris; for chemistry, Prof. Arrhenius, of Stockholm; for medicine, Prof. Finsen, of Copenhagen. The formal distribution of the prizes took place on 9th inst. in the presence of the King of Sweden and a distinguished gathering. After the usual speeches, the prize-winners present, MM. Becquerel and Arrhenius, received their prizes, with the diploma and Nobel gold medal. Prof. Finsen and M. and Mme. Curie were represented by the Danish and French Ministers. Prof. Finsen has decided to give 50,000 kroner (£2,753) from the amount awarded to him to the Phototherapeutic Institute.

Royal Commission on London Locomotion.—At the sitting of the Royal Commission on December 10th, evidence was given by Mr. R. F. Wheer, chairman of the Works Committee of the Paddington Borough Council, by Mr. Wm. Nisbet Blair, borough engineer of St. Pancras, and by Mr. W. C. Leete, Town Clerk of the Borough of Kensington.

At the sitting on December 11th, evidence was given by Mr. H. C. Jones, the Town Clerk of Holborn. Mr. H. C. J. Edwards, borough engineer of Lambeth, and Mr. T. W. E. Higgins, borough engineer of Chelsea.

The Indian Government Electrical Department.—The present-day tendency to specialise is making itself felt in Government departments. It is quite on the cards that a separate department will be formed to deal with electrical engineering matters. Mr. Meares's office is growing, his latest recruit being Mr. Jordan, who had formerly charge of the electric installation at Viceregal Lodge, Simla, and who was till recently attached to the First Calcutta Division. In future all officers in Bengal engaged in any way on electrical engineering duty will be under the orders of Mr. Meares.—*Indian Engineering.*

The Municipal and County Club.—Sir Samuel Provis, K.C.B., secretary of the Local Government Board, was the guest of the evening at the house dinner of the Municipal and County Club, held at Whitehall Court, Mr. Laurence Gomme, F.S.A., clerk to the London County Council, presiding.

Electrical Volunteers.—The *London Gazette* of December 11th contained a notice to the effect that Messrs. E. G. Sheppard and G. D. Leys had been appointed second lieutenants.

Phenomena of the Mercury Arc. — M. Valbreuze, in the *Comptes Rendus*, November 30th, describes peculiarities of the arc between electrodes of mercury. The anode, at the beginning, is luminous in part, then covered by brilliant stars in geometrical figures, such as a pentagon or hexagon. As the electrode heats, the stars become larger and appear as luminous pearls on the mercury. Afterwards they coalesce into a luminous disc, surrounded by one or more luminous rings, with dark rings between. Lastly, the dark rings disappear and the anode takes its usual aspect of a luminous ground. The explanation he suggests is the existence on the surface of the mercury of a membrane more or less permeable by the current, and that its vibration determines the regular form of the figures observed.

The Resistance of Selenium.—A. B. Griffiths finds that the electrical resistance of selenium is diminished by exposing it to an alcoholic solution of certain animal and vegetable pigments. The following figures show the effect produced by an exposure of 15 minutes at a distance of 15 centimetres to the solutions mentioned. The quantities are in megohms, before and after treatment:—Petals of the verbena, from 0·34 to 0·29; of the helianthus, from 0·42 to 0·415; of the geranium, from 0·462 to 0·32. A solution containing *bacterium allii*, from 0·39 to 0·37; pelageine (a pigment from the Medusa) from 0·35 to 0·33; diemyctylin (from the lizard), from 0·444 to 0·41; amanitin (from the fungus *Agaricus muscarius*), from 0·38 to 0·36. It is known that light, the rays from radium, and the Röntgen rays reduce the resistance of selenium, and it seems possible that the pigments mentioned also emit such rays. It is also interesting to note that Edison has shown that chlorophyll, curcumine, and daturine produce phosphorescence.

The Electrical Heating of Trains.—Writing in *L'Electrochemie* lately, Tommasi suggested that trains might be conveniently heated by means of a combined electrical and physical method. The heating dynamo, driven from a carriage axle as usual, evolves current which is led in the ordinary way to radiators placed in the desired situations: but these radiators consist of apparatus filled with a solution of sodium acetate or thiosulphate (the photographer's hyposulphite). These liquids are distinguished by the large amount of heat they emit when crystallisation occurs. When, therefore, the train is travelling at a sufficient speed to cause the dynamo to generate current, the energy passes into these radiators, liquefies the crystals, and raises the temperature of the resulting liquid to a point at which they are able to warm the coaches; but when the train stops, even for any period of time up to six hours or so, the solidification of the crystals causes heat still to be passed into the train. The apparatus, in fact, is an adaptation to an electrical source of heat, of the similarly constructed footwarmers in use for many years on certain lines; the difference being that the salts are melted in their water of crystallisation by current instead of by placing the whole arrangement in a steam or hot-air oven.

A Double Carbide of Tungsten and Chromium.—Moissan and Kouznitzow have prepared in the electric furnace a double carbide of tungsten and chromium which has the formula $W_2C, 3Cr_3C_2$. This body has a specific gravity of 8·41. It is very stable, is not attacked by acids or the chief reagents of the chemist, and is remarkably hard. This last fact leads the authors to think that an addition of tungsten to chromium steel might cause the double carbide to be produced, and might, therefore, yield a metal having new and peculiar properties.

The Consumption of Calcium Carbide.—According to one of the French acetylene journals, the amount of carbide actually consumed in that country during 1902 was 12,500 metric tons, and the amount likely to be consumed during the current year is estimated at 15,000 tons. Placing the most important countries in order of decreasing carbide consumption, our informant gives us the following list:—France, Italy, Germany, United States, Spain, Sweden and Norway, "England," Austria-Hungary and Canada. There would seem, however, to be some mistake in this list, because at the recent annual meeting of the German Acetylene Association, the president, Dr. Dieffenbach, gave a careful estimate of the consumption in Germany, and returned it at over 20,000 metric tons, 6,600 of which are consumed by the railways. However this may be, the most noteworthy feature of the list is the high position ascribed to Italy. In 1897 the amount of calcium carbide consumed there was only 400 tons, but it has risen yearly to 650, 1,300, 3,100, 8,400, 12,500, and to 13,000 for the first nine months of 1903.

Personal.—Mr. A. B. Fearnley, general manager of the Birkenhead Corporation tramways, has been selected by the Tramways Committee of Sheffield for recommendation to the Council for the position of tramways manager of that town. For 14 years before going to Birkenhead, he was at Bradford, during the latter part of the time as manager of the tramways. There were 80 applicants for the Sheffield position.

At the meeting of the Sunderland T.C. on the 9th inst. Mr. A. R. Dayson was appointed tramways manager in succession to Mr. H. England. The salary is £400, advancing to £500. Mr. Dayson had been assistant tramways engineer previously. There were 74 applications.

Willesden.—On December 5th 30 members of the Arc Works Engineering Society (Chelmsford), paid a visit on Saturday to the works of the Metropolitan Electric Supply Co. at Willesden. On the following Tuesday Mr. Brunton gave a lecture to the Society on "Building Materials."

Efficiency of a Four-Valve Fleming Engine.—Mr. B. T. Allen's paper of December, 1903, to the American Society of Mechanical Engineers is practically a protest against complicated valve gears as an aid to economy. The Fleming engine is apparently a Corliss engine without Corliss cut-off gear. The valves are driven somewhat as in the old Porter-Allen engine by unequal-angled levers, so as to have waiting periods, and periods of rapid cut-off movement. The indicator diagrams, therefore, while not giving absolutely sharp corners at cut-off, are rationally proportioned. The Rockwood idea of cylinder ratio of 7·33 to 1 is adopted, and with a boiler pressure of 163 lbs. absolute, and a 26-in. vacuum, a 500-H.P. engine worked at 353·56 H.P. with a steam consumption of 12·33 lbs. per H.P.-hour. There were neither jackets nor superheat, and the cut-off steam shown by the diagrams was 7·88 and 8·27 lbs. in the high-pressure and low-pressure cylinders respectively, and 9·94 and 9·02 lbs. respectively at release—that is to say, 63·9 and 67·0 per cent. at cut-off, and 80·6 and 73·2 per cent. at release respectively of the whole steam consumed. At full load the steam accounted for by the diagram was 89·2 and 92·4 per cent., with a power of 500·66, and steam consumption of 12·66 lbs. per I.H.P.-hour, the initial absolute pressure being 159 lbs., and the vacuum 26 in. The steam consumption per I.H.P.-hour is therefore greater at full load, though probably less per B.H.P. At one-sixth load the steam consumption, including reheater, was 14·42 lbs., at seven-tenths load it fell to 12·33, and at eleven-tenths load it had risen to 12·73. The diagrams at seven-tenths load, when combined, appear closely to approximate to the theoretical curve, by which we suppose the hyperbola is intended. This point is emphasised unduly. As a matter of fact, the H.P. card starts on the hyperbola, rises above the curve, and proves a good deal of condensation and re-evaporation. The L.P. card starts below the hyperbola and rises up to it, showing the same fault, which can only be amended by superheat or jacketing. The conclusion intended to be pointed is that simple valves, simply moved, are quite as good as the complicated devices wrongly credited with the economy that, at any rate, as regards the Corliss valve, was really due to the good cylinder drainage it secured when placed at the four corners of the cylinder.

Electricity in the Manufacture of Iron and Steel.—The *Standard* correspondent at Ottawa says that Mr. Sifton, the Minister of the Interior, is arranging, on behalf of the Dominion Government, to send a Commission to Europe to investigate the processes of manufacturing iron and steel by electric treatment. There are immense iron deposits in Canada, which cannot now be worked on account of the cost of the fuel. The Commission will visit France, Italy and Sweden, and will report if the processes now being successfully used there would be a commercial success in Canada.

The Electricals.—To-night the second Bohemian concert of the Electricals is to be held at the Frascati Restaurant at 7.45 p.m. sharp.

English Electrical Engineers in Morocco.—Reuter reports that two English electrical engineers left Tangier on 8th inst. for the Shereefian Court to take up positions in the service of the Sultan.

Institution of Electrical Engineers (Newcastle Section).—Last Monday Dr. W. M. Thornton read a paper on "Experiments on Eddy Currents."

Rugby Engineering Society.—At last night's meeting of this society, Mr. E. A. Reynolds read a paper on "The Economy of Superheated Steam."

King's College Engineering Society.—The 10th annual dinner of the above society took place on December 5th at the Hotel Cecil, Sir John Wolfe Barry, K.C.B., F.R.S., being the guest of the evening. Prof. D. S. Capper occupied the chair. The Vice-President of the Society, Mr. B. G. Cooke, in toasting "Our Guest," stated that the Society was proud of the fact that Sir John Wolfe Barry was formerly a student and member of the Society. Sir John Wolfe Barry, in replying, said that the profession which he had followed was the most delightful in the world; in discussing the present day education, he deprecated "cramming," and showed great faith in the sandwich system. "The College and Staff" was proposed by Mr. Rowley. He stated that the College deplored the loss of Prof. W. H. Hudson. This was replied to by the Vice-Principal, Prof. Adams, and Prof. Hudson. Prof. Capper proposed "The Engineering Society," this toast being replied to by the President, Mr. F. W. Crawer Roberts. He pointed out the flourishing state the Society was in, both as regards roll of membership, in which a record had been attained, and the quality of the papers read during this session. Mr. Franks then proposed "The Chairman." The programme was well supplemented by Mr. Algernon Clarke's orchestra, and a flute solo by Prof. E. Wilson. Mr. Stavers, who so successfully organised the dinner last year, again gave his assistance.

Mechanical Stokers.—A slight inaccuracy occurred in our article on p. 966 of our last issue. For the "E.S." read "E.S.E." (Economy, Simplicity, Efficiency), it being the stoker of the Smoke Preventer Co., Ltd., of Blackburn, whose appliance was referred to.

Appointments Vacant.—Electrical engineer for Sunderland Corporation tramways department (£200); engineer-in-charge for Wimbledon (£78); resident electrical engineer for Leicester tramways (£250); assistant electrical engineer for Lancashire County Asylum (35s.); resident working engineer (40s.+), and electrical assistant (35s.+), for New Hollymoor Asylum, Birmingham; an assistant is required in the electrical engineering department at the C.T.C., Exhibition Road, S.W., £150.

Suppression of Hysteresis by an Oscillating Magnetic Field.—Recent experiments have drawn attention to the action of a rapidly varying magnetic field on magnetism produced under ordinary conditions. M. Maubain, in the *Comptes Rendus*, for November 30th, describes experiments leading him to conclude that it is the hysteresis in relation to the field which is affected, and even entirely suppressed. An iron or a steel core being submitted to a cycle of magnetic field at the same time as to the continuous action of a field oscillating in the same direction, we get instead of the well-known curve of magnetisation with two branches, a single curve, on which are placed all the points obtained with an increasing or diminishing field. It is necessary that the core be thin enough for the oscillating field to penetrate with sufficient intensity into its central part. The cores employed in his experiments were pieces of untempered or tempered chronometer spring 0·1 to 0·15 millimetre thick, by 0·2 to 1 millimetre broad, and cylindrical stems of porphyrised iron and of steel fixed in a glass tube by paraffin. They were surrounded by two very long bobbins, the outer the magnetising bobbin, the inner a single layer of well-insulated wire traversed by the electric oscillations produced in the following manner:—The coatings of a Leyden jar were connected on one hand to the pole of a Ruhmkorff coil, and on the other to the ends of the inner bobbin through a spark micrometer. The intensity of magnetisation was measured by an astatic magnetometer giving a sensibility which, owing to train-lines, could not be obtained with a non-astatic magnetometer. The thinnest untempered specimens gave complete suppression of hysteresis, but in the thick specimens the branches of the curves were separated, and the more so the thicker the specimen. The tempered specimens gave like results, but needed more intense oscillations. The porphyrised iron lost its hysteresis. Those values of magnetisation got during the action of the oscillations were more elevated than under ordinary conditions. The preceding results were obtained when the primary coil of the Ruhmkorff was magnetised by an alternating current, that is, when the effects of induction were symmetrical. A continuous current interrupted, giving dissymmetrical-induction effects, gave different results. The oscillations which are always in the same direction at the outset of each oscillatory discharge, provoke when they act alone, a strong magnetisation in a determined direction, which persists after they stop. The alternate current oscillations, on the other hand, do not of themselves produce any fixed magnetisation. The non-symmetrical induction gives a curve of magnetisation which passes for a zero field through the point representing the magnetisation due to oscillations, instead of through the origin. Moreover, this curve is only reversible for a suitable intensity of oscillations in the part where the direction of the magnetising field, and that of the magnetisation due to oscillations, coincide. In the other part the two branches are a little separated. The continuous action of oscillations with sufficiently thin specimens yields reversible curves well determined and rising rapidly without bend from their origin.

THE CENTRAL STATION ENGINEER.

MR. E. M. HOWE, of Blackburn, has been appointed engineer-in-charge at Wimbledon electricity works.

Mr. S. W. HOSKING, of the Isle of Thanet Electric Tramways and Lighting Co., Ltd., has been appointed switchboard attendant at the Bath Electric Tramways.

The following increases of salary have been made in the tramways department by the Tramways Committee of the Sheffield T.C.:—Mr. H. E. YERBURY, electrical engineer, from £280 to £300; Mr. R. G. THOMAS, technical instructor, from £200 to £220; Mr. E. J. MARSH, chief electrical superintendent, from £200 to £220. In the electrical supply department the following increases have been granted:—Mr. A. CUTHILL, station superintendent, from £283 to £300; Mr. J. W. BARNES, wiring and fitting department, from £250 to £262 10s. The Town Council has appointed Mr. J. W. BEAUCHAMP to succeed Mr. A. DOXEY as chief assistant electrical engineer and deputy-manager of the electric light works.

The Yale Electric Power Co.'s employés held their annual dinner at the Maenofferem Hotel on Thursday last week. Mr. R. CROOK (chairman) enumerated the events of the year. Mr. DAVIES proposed the toast of "The Company," coupled with that of Mr. T. P. O. YALE. Mr. S. B. WAINWRIGHT, in replying, showed the progress of the public and private lighting, and also strongly repudiated the attack of the Council. Mr. T. GRIFFITHS (Sandycroft) replied to the toast of the "Army and Navy." Mr. J. T. OWEN and Mr. J. JONES replied to the toast of "The Town and Trade of Blaenau and District," and said that they fully agreed with what had been said at that meeting regarding the public lighting of the town. The dinner was followed by music and songs.

The salary of Mr. MOXON, mains superintendent at Huddersfield, has been increased to £130 per annum.

The Manchester Electricity Department has now made an appointment to fill the vacancy created by Mr. G. F. METZGER'S resignation of the position of "chief." Mr. METZGER'S services in that capacity terminate at the end of January, but the committee invited him to continue to act in a consultative capacity until the Stuart Street scheme is completed, at a fee of £150 per quarter. His place as chief engineer will be taken by Mr. STANDEN LEONARD PEARCE, who joined the Corporation staff in 1901 as deputy chief electrical engineer. Mr. PEARCE has been appointed under a provisional arrangement for a term of twelve months, at £800 per annum. An assistant engineer is to be appointed at a salary not exceeding £250. Mr. PEARCE is only 31 years of age, but he has had very wide experience in electric lighting and tramway work, having been in his time with Messrs. J. G. Statter & Co., Messrs. Thomas Richardson & Sons, of West Hartlepool, on the ships of the British India S. N. Co., as assistant engineer to the Metropolitan Electric Supply Co.; thereafter he was with the British Thomson-Houston Co.; and later, just previous to his going to Manchester, he had held the position of superintendent engineer at the Central London Railway power station at Shepherd's Bush. We wish Mr. PEARCE every success in the very important position in which, subject to the Council's confirmation, he has been placed.

At Bootle, Mr. J. B. HUDSON, senior assistant, has been appointed to act as deputy electrical engineer during the absence of the chief, and Mr. E. W. KING has been appointed assistant at a salary of £100 per annum.

NEW COMPANIES REGISTERED.

British Johns-Manville Co., Ltd. (79,272).—This company was registered on November 28th, with a capital of £5,000 in £1 shares, to carry on the business of dealers in and importers, exporters and manufacturers of all kinds of electric, magnetic, galvanic, chemical and other machinery, apparatus and appliances, materials and substances used by electrical and other engineers, and in particular steam ammonia, water packing used in the construction of engines, asbestos goods, paint, vulcabeston fuses known as "Noark" fuses, overhead material known as "moulded mica," insulating material known as "Monarch moulded," and heaters known as "H. W. J. Heaters." Possible agreements with the M. Johns-Manville Co. are provided for. The first subscribers (each with one share) are:—E. W. Williams, 11, King William Street, E.C., solicitor; C. E. Barker, 3, Waverley Place, St. John's Wood, N.W., solicitor; H. J. Joseph, 81, Fenchurch Street, E.C., manager; D. E. Gudgeon, 81, Fenchurch Street, E.C., accountant; H. W. Young, M.I.C.E., 12, Camomile Street, E.C., electrical engineer; E. Bergthiel, 12, Camomile Street, E.C., electrical engineer; and A. V. W. Milne, 80, Budge Row, Cannon Street, E.C., solicitor. No initial public issue. The number of directors is not to be less than three nor more than five; the first are H. J. Joseph, G. W. Becker and E. Bergthiel; qualification, £100; remuneration as fixed by the company. Registered office: 81, Fenchurch Street, E.C.

British Cable Syndicate, Ltd. (79,401).—This company was registered on December 11th, with a capital of £3,000 in £1 shares, to carry on the business of electricians, electric, mechanical, sanitary, gas and water engineers, ironmongers, makers of electric tramcars, motor cars, carriages, cycles and other vehicles, manufacturers of and dealers in electric light cables, telegraph and other wires and accessories, dynamos, motors, telephones, bells, electroliers, arc and other lamps and electric light fittings, &c. The first subscribers (each with one share) are:—T. J. Booth, 24, Harley Street, Bow, E., clerk; F. Maddocks, Oakfield, Sheridan Road, Merton Park, clerk; May W. Vockins, 28, Lavender Sweep, Clapham Junction, clerk; R. Salem, 70, Bishopsgate Street Within, E.C., gentleman; J. A. Halford, 4, Devonshire Terrace, W., engineer; O. J. Parker, 70, Bishopsgate Street Within, E.C., merchant; and T. Bremner Acacia, Frognal, N.W., surveyor. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £10; remuneration, £25 each per annum, and 5 per cent. of the net profits, divisible. Registered office: 70, Bishopsgate Street Within, E.C.

Etheridge Railway Co., Ltd. (79,359).—This company was registered on December 8th, with a capital of £30,003 in 300 ordinary shares of £100 each and 60 "B" shares or 1s. each, to acquire concessions, rights and privileges for the construction of railways and tramways in Queensland or any part of the world, and to carry on the business of carriers of passengers and goods, engineers, contractors, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, and of generators, transmitters, users and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, compressed air, gas, steam, oil or otherwise, &c. The first subscribers (each with one share) are:—L. G. Harvey, 201, Fulham Road, S.W., clerk; E. M. Cope, 16, Stanmore Road, West Green N., clerk; L. H. Lepingwell, 312, Romford Road, Forest Gate, E., clerk; L. G. Romer, 156, Graham Road, N.E., clerk; L. E. Lawton, 19, Sach Road, Upper Clapton, N.E., clerk; K. H. Thomas, Elmbank, Pirbright, Surrey, clerk; and H. H. Sharman, 13, Powell Road, Clapton, N.E., clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration, £100 each per annum.

Synchronised Electric Clock Co., Ltd. (79,362).—This company was registered on December 8th, with a capital of £2,500 in £5 shares, to acquire the following provisional specifications for patents, viz., No. 18,679, dated August 25th, 1903, of W. W. G. Webb, J. Hall and F. A. Chandler, relating to improvements in clocks; No. 22,858, dated October 22nd, 1903, of F. A. Chandler and B. Bonniksen, for improvements in electrically synchronised clocks and the like, and 24,684, dated November 16th, 1903, of the said F. A. Chandler and B. Bonniksen, for improvements in electrical clocks; to lodge complete specifications of and complete such patents and to manufacture and dealer in electrical and patent clocks, &c. The first subscribers are:—W. Davis, C.C., 16, St. Mary's Road, Leamington Spa, gentleman, 10 shares; H. E. Thornley, The Mall, Radford Semele, near Leamington Spa, brewer, 10 shares; R. S. Gold, 79, Coten End, Warwick, gentleman, 10 shares; G. Norris, C.C., 9, Radford Road, Leamington Spa, coal factor, 10 shares; W. G. Leigh, Rusina, 3, Charlotte Street, Leamington Spa, gentleman, 10 shares; C. E. Burges, J.P., Tachbrook House, Leamington Spa, tea dealer, &c., 10 shares; and F. W. Francis, J.P., Hyde House, Leamington Spa, draper, 5 shares. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are B. Bonniksen, 16, Norfolk Street, Coventry; J. H. F. A. Chandler, 4, Victoria Terrace, Leamington Spa; W. Davis, C.C., R. S. Gold, W. G. Leigh, G. Norris, C.C., and H. E. Thornley; qualification, £50; remuneration as fixed by the company.

Kroeger Light-Cure and Electro-Therapeutic Institutes, Ltd. (79,345).—This company was registered on December 7th, with a capital of £15,000 in £1 shares, to acquire the goodwill of the businesses heretofore carried on by M. Kroeger at 67, Elizabeth Street, Eaton Square, S.W., and 11, Grand Parade, Eastbourne, by the said M. Kroeger, and Mrs. I. Maxwell, at 12 Cheniston Gardens, W., and by the said M. Kroeger, A. L. Smith and Miss E. W. Smith, at Mansion House Chambers, 11, Queen Victoria Street, E.C., under the style of "Kroeger's Light-Cure Institutes," and to carry on the business of proprietors of hospitals, sanatoria, hydropathic and other establishments, spas, medicated, light, electric, Turkish, vapour or other baths, medical, nursing, convalescent and other homes, laboratories and institutes for the treatment, alleviation and cure of diseases and ailments, &c. The first subscribers are:—M. Kroeger, 6, Croxted Road, West Dulwich, electro-therapeutist, 10 shares; A. S. Smith, 131, Holbein House, Sloane Square, S.W., electro-therapeutist, 1 share; E. T. Peach, 11, Grand Parade, Eastbourne, electro-therapeutist, 1 share; F. Wilde, 12, Cheniston Gardens, W., electro-therapeutist, 1 share; Mrs. I. Maxwell, 1, Ember Villas, East Molesey, 1 share; G. R. Taylor, 7, Spring Street, Hyde Park, W., clerk, 1 share: and Miss E. W. Smith, 26, Moore Street, Lennox Gardens, S.W., 1 share. Minimum cash subscription, 1 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than seven; M. C. A. C. Kroeger is the permanent managing director; remuneration, £500 per annum, or 5 per cent. of the gross profits, whichever is the greatest, provided that such remuneration shall not be paid until £5,000 of the capital has been subscribed, subject to payment in cash.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sherard Cowper-Coles & Co., Ltd., electricians, London (67,136).—Issue, on November 13th, of a debenture for £100, part of series created by resolution of December 3rd, 1901, and February 7th, 1902, to secure £6,500, charged on the company's real and personal property, present and future, except uncalled capital. No trustees. Previously issued of same series: £6,400.

British Prometheus Co., Ltd., electrical engineers, Kingston-on-Thames (74,889).—A memorandum of satisfaction in full of a debenture dated August 15th, 1903, securing £150, has been filed.

Brockie-Pell Arc Lamp Co., Ltd. (66,602).—A debenture created 27th, and dated November 30th, 1903, to secure not more than £1,000, charged on the company's property, present and future, including uncalled capital, has been registered. Holders: Barclay & Co., Ltd., 54, Lombard Street, E.C.

Atlas Engineering Co., Ltd., electrical and general engineers, Southport (64,320).—A second mortgage debenture, dated November 26th, 1903, to secure £100, and a third mortgage debenture, dated November 27th, 1903, to secure £50, charged on the company's undertaking and property, present and future, including uncalled capital, subject to mortgage debenture dated December 14th, 1899, has been registered. Holders: J. Malam, 50, Everton Road, Birkdale, and Mrs. M. A. Pollitt, 57, Norwood Road, Southport.

Consolidated Telephone, Construction and Manufacturing Co., Ltd. (15,212).—In liquidation: A memorandum of satisfaction in full of a debenture dated September 3rd, 1902, securing £9,500, has been filed.

Sharpe & Co., Ltd. (electrical and general engineers, Grimsby).—Issue on November 23rd, of £800 debentures, part of series created December 14th, 1899, to secure £2,500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £1,000.

Keynsham Electric Light and Power Co., Ltd.—Issue on November 30th, of £1,200 debentures, part of series created same date, to secure £1,500, charged specifically on the company's freehold land and buildings at Keynsham, and as a floating security on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Atlas Engineering Co., Ltd. (64,320).—This company's annual return was filed on December 5th, when 860 shares had been taken up out of a nominal capital of £2,000 in £1 shares. £1 per share has been called up on 860 shares, resulting in the receipt of £860. Mortgages and charges: £200.

Walsall Electrical Co., Ltd. (37,696).—This company's annual return was filed on November 14th, when 16,380 shares had been taken up out of a nominal capital of £25,000 in £1 shares. £1 per share has been called up on 14,380 shares, resulting in the receipt of £14,380. 2,000 shares are considered as fully paid. Mortgages and charges: £4,000.

Edison & Swan United Electric Light Co., Ltd. (18,984).—This company's annual return was filed on December 1st, when 116,400 "A" and 23,564 "B" shares had been taken up out of a nominal capital of £1,000,000 in 150,000 "A" and 50,000 "B" shares of £5 each. 10s. per share has been called up on 89,261 "A" shares, resulting in the receipt of £44,630 10s. £456,667 10s. is considered as paid, being £5 per share on 17,139 "A" and 23,564 "B," £2 10s. per share on 89,261 "A" and £3 per share on 10,000 "A" shares. Mortgages and charges: £444,023.

Hove Electric Lighting Co., Ltd.—A debenture dated November 23rd, 1903, to secure £7,500, supplemental to a trust deed dated June 30th, 1896, to secure an unspecified amount of debenture stock, but stamped to cover £50,000, has been registered. Property charged: the company's undertaking and property, present and future. Trustees: Col. A. J. Filgate, R.E., 106A, Jermyn Street, London; and C. F. Tufnell, Lloyd's, E.C.

Provincial Electric Construction Co., Ltd.—Issue on November 24th of £800 debentures, part of series created November 20th, 1903, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Blackpool, St. Annes and Lytham Tramways Co., Ltd. (59,184).—A trust deed dated November 19th, 1903, to secure £150,000 debenture stock created by resolutions of November 12th and 26th, 1903, and as collateral security thereto three debentures of even date, each for securing £50,000, have been registered. Property charged: Certain leasehold hereditaments, the benefit of certain agreements, and the company's undertaking and property, present and future, including uncalled capital. Trustees: J. Heap, J.P., Red Lees, Blackpool; J. S. H. Banner, J.P., 24, North John Street, Liverpool; and J. M. Walker, Pell Wall, Market Drayton.

A memorandum of satisfaction in full of second mortgage debentures created by a resolution of March 1st, 1,901, securing £12,000, has been filed.

Geneva Tramways Co., Ltd. (72,081).—Debentures for £9,692 7s. 9d. (39 of £1,000 each, and one of £692 7s. 9d.), created by resolution of November 5th, and dated December 7th, 1903, have been registered. Property charged:—The company's undertaking and assets, present and future, subject to an agreement, dated June 30th, 1903, with the London Trust Co., Ltd., and Messrs. L. Hirsch & Co. No trustees. Holder:—A. Ries, Warnford Court, E.C.

ELECTRICITY SUPPLY ACCOUNTS.

Southampton Municipal Electrical Supply.

The year ending March 31st last proved a record one for the Southampton undertaking. Increased revenue and decreased working expenses produced the most satisfactory balance which the department has had so far.

The notable feature is the reduction in total works costs, which are less, both in the total and per unit, than last year, despite an increased output of 300,000 units. The total works costs now stand at 1·64*d.* per unit—a drop of ½d. on 1892, and at their present level occupy a very favourable position among similar undertakings. The prices for energy are:—Private lighting, 6d. and 4½d. per unit, on the maximum demand system; traction, 2d. per unit.

The borough electrical engineer is Mr. H. F. Street.

GENERAL STATEMENT.

For year ending March 31st—	1903.	1902.
Total capital expended	£133,502	£122,188
Number of units sold—		
Private supply	624,312	589,042
Public lighting	130,297	117,701
Traction	977,404	723,479
Total number of units sold	1,732,013	1,430,222
Equivalent No. of 8-C.P. lamps connected	46,600	41,080
Number of public lamps	166	166
Maximum load in KW.	1,263	1,143
Revenue account—		
Gross revenue	£23,829	£20,872
„ expenditure	£11,891	£12,916
„ profit	£11,938	£7,956
Average price obtained—		
Private lighting...	5·20d.	—
Public lighting	3·20d.	—
Traction	2·00d.	—

REVENUE ACCOUNT.

	1903. Gross.	Per unit.
By sale of energy	£23,379	3·24d.
Meter rents, &c., ...	301	·04d.
Sundry receipts, rents and premiums	149	·02d.
Gross revenue	£23,829	3·30d.

COST OF PRODUCTION.

	Gross.	Per unit.
Coal and oil fuel	£5,044	·70d.
Oil, waste, water and engine room stores ...	482	·07d.
Wages incurred in generation and distribution	1,845	·25d.
Repairs and maintenance of buildings, machinery and plant...	1,862	·26d.
Works and distribution costs	£9,233	1·28d.
Repairs and maintenance, public lamps ...	315	·04d.
Rents, rates and taxes	967	·13d.
Management expenses, salaries of engineer and clerical staff	943	·13d.
General establishment charges, insurance, law, printing, and stationery	433	·06d.
Total works costs	£11,891	1·64d.

PROFIT STATEMENT.

Interest on loans, &c.	£3,778
Sinking fund	3,897
Balance for the year carried down...	4,268
Gross profit	£11,938

With a greatly improved gross profit and financial charges, only moderately increased, the department was able to carry forward a balance of £4,268. Out of this, special expenditure on machinery, amounting to £2,018, was met, and a depreciation and renewals fund started.

CITY NOTES.

British Electric Traction Co.

THE interim report of the directors, dated December, 1903, reads as follows:—

"Having regard to the very unfavourable weather which has prevailed throughout the year, the traffic receipts of the various associated undertakings on the whole show satisfactory increases. During the present year over 50 route-miles of new or reconstructed tramways or light railways have been opened for traffic by electric traction on the overhead system. The policy of the directors for some time past has been to restrict as much as possible the further capital commitments of the company on new schemes or extensions, and the attention of the management is now mainly concentrated upon increasing the revenue from the company's present investments. No portion of the additional debenture capital authorised at the last general meeting has yet been issued.

"The Auckland Electric Tramways Co., Ltd. (New Zealand), in which the company has an interest of nearly £300,000, has been successfully established. Some of the lines were opened for traffic at the end of last year, and others during the present year. The traffic receipts are satisfactory and in excess of the estimates, and it is expected that a dividend will be paid on the ordinary shares of the Auckland Co. for this, the first year of working by electric traction.

"The business of the Metropolitan Electric Tramways, Ltd., in which the company holds shares to the amount of about £219,000, and has guaranteed to raise further capital to the extent of about £300,000, is also developing satisfactorily. That company will eventually operate, in the important area north of London, about 48 miles of light railways, under leases from the County Councils of Middlesex and Hertford, in conjunction with its own 8½ miles of tramways. It also holds about 70 per cent. of the capital of the North Metropolitan Tramways Co. and all the issued share capital of the North Metropolitan Electric Power Supply Co., which latter company owns Acts of Parliament authorising the supply

in perpetuity of electricity in bulk in an area of about 325 sq. miles in Middlesex, Hertford and Essex. Considerable progress is being made by the County Council of Middlesex, and by the Metropolitan Co., in the construction of the lines and works, and it is hoped that about 20 miles of lines will be opened for traffic by electricity on the overhead system, early next summer.

"Arrangements are in progress for the consolidation of the company's interests in the various associated companies in Birmingham and adjacent districts, now operating about 90 route-miles of tramways and light railways.

"During the past session the company has obtained an Act of Parliament authorising the reconstruction for working by electric traction of the existing Brighton and Shoreham tramways and extensions of the lines to Worthing. The tenure of the greater part of the lines is for 42 years, and the company has obtained a favourable purchase clause.

"The company has also obtained an Act of Parliament authorising the construction of further tramways in the neighbourhood of Croydon, forming extensions of the existing Croydon electric tramways, thus completing an important network of tramways of about 30 route-miles.

"Generally the business of the company is developing satisfactorily."

Douglas Southern Electric Tramways Co.

The report for the year ended October 31st, 1903, states that the season consisted of 123 days, as against 137 days last year. The mileage run was 32,343.77, as against 32 504 09 last year. The Manx season was very considerably marred by the general wet and stormy summer, but, notwithstanding this, the line had been well patronised. The gross earnings were £4,962, as against £4,733 last season—an increase of £229. The tolls payable to the Douglas Head Marine Drive, amounting to £827, must be deducted, leaving net passenger receipts £4,135; to this must be added £19 sundry receipts, making a total of £4,153, as against £3,967 last year. The net profit for the year is £1,965, as against £1,952 last year, which, added to the balance from last year, £212, gives a total balance of £2,177. The directors recommend a full dividend of 7 per cent. upon the preference shares, which will absorb £1,818, and leave the sum of £359 to be carried over.

Provincial Tramways Co.

The directors report that, notwithstanding the unfavourable weather, the net revenue received from the local companies in the year ended September 30th amounted to £23,353, as compared with £18,551 in the preceding year. The directors have set aside £6,000 for depreciation, and including the balance brought forward, there is an available total of £18,794. Dividends upon the ordinary shares of 6s. each are declared, leaving £2,742 to be carried forward. In the last report it was stated that the company remained in possession of the Gosport undertaking, in consequence of the notice to purchase given by the District Council proving to be invalid, and that they had deposited a Bill for an electric tramway from Gosport to Fareham, Porchester and Cosham. This Bill was strenuously opposed by the London and South-Western Railway, but Parliament ultimately passed the Bill authorising an electric tramway from Gosport to Fareham, striking out the portion from Fareham to Cosham. The directors will have to consider, in the spring, how best to carry out this undertaking.

Aron Electricity Meter, Ltd.

The sixth ordinary general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, Old Broad Street, Mr. H. Hirst presiding.

The Chairman, in proposing the adoption of the report, remarked that while he did not wish to imply that he considered this year's balance-sheet a particularly satisfactory document, whoever knew what it meant to turn a concern that had lost in one year over £6,000, into a successful business again, would appreciate that if his hopes had not been realised within the past year, there were strong symptoms that they were on the road to realise them. They had last year a loss of £6,032, and had to pay £2,500 out of capital towards sinking fund. This year, after a liberal writing off, they had made no loss, and had been able to provide practically the whole of the sinking fund out of profit. The balance-sheet for the past year was a healthy one as compared with 1902, in so far as they had amply depreciated, and the decrease in stock and sundry debtors of £9,370 was represented by about £10,000 additional hard cash. These were distinctly encouraging symptoms, considering their position 12 months ago; and the results would have been better had it not been for three particular causes which showed themselves in the shape of expenses against the year's trading. First, the stagnation prevalent in business last year led the directors to make serious efforts to endeavour to apply some of the unused capital at their disposal for new enterprises. Experiments had been made, negotiations carried on, and preliminary expenses incurred for the purpose of investigating such things as an automatic prepayment gas meter, an electric ignition apparatus in connection with a petrol engine for motor cycles, and a simple and cheap speed indicator for motor cars and other machines. He regretted to say that none of these investigations and experiments were sufficiently encouraging to warrant them investing any of their capital, and the several hundred pounds spent had gone towards the general expenses of the year, though they considered they were well justified in spending the money. One particular reason why they decided not to press on with those supplementary manufactures was the resuscitation of their own business. The second cause was the continuance of experiments with a new meter and the taking out of patents for the same which they considered most valuable. All expenses connected therewith had been defrayed out of the year's trading, and amounted to nearly £1,000. Dr. Aron had succeeded in finishing what appeared to be an excellent little meter for alternating currents, which would very shortly be on the market. He was satisfied with the technical success of the meter, while, so far as he (the chairman) could judge as a manufacturer, he believed they would be able to produce it sufficiently cheaply to compete. The third item which had worked against this year's profit was the expenditure of several thousand pounds for the purpose of making good the meters in this country which they supplied two or three years ago, and which developed faults in practical use. They had succeeded in nearly every instance where they had undertaken the task, in proving the worth of the meters, as they were now working reliably, and he hoped they would be rewarded with orders in the future. Regarding the financial position, the assets of the company were rather better than at any time since its formation, and that in spite of a debenture issue of £60,000. As regarded the commercial outlook, the business had assumed a different aspect in various countries. In Germany they had been eminently successful, especially during the latter half of last year. They had sold as many meters throughout the year as they had done in any one year previously, but competition, of course, forced them to sell them at a cheaper rate, and therefore their profit was not what it used to be. The pleasant feature of the increase in sales was, that they were not only due to one or two customers, but they supplied 150 stations in Germany, and they had increased their business with nearly all of them. In Austria and France the business had been neither progressive nor retrogressive; they had held their own. In this country, however, they were in a rather peculiar position. A few stations that had used their meters in large quantities, after having once or twice given other meters a chance, had again returned to them. One company had, within the last three months, made a contract for three years for at least 2,000 meters. Another company has given them an order for a large number of meters. They had had testimonials from some stations that the meters which had given them at one time a great deal of trouble were now giving most satisfactory results, and if orders had not yet come in, he ascribed it to principally one reason—meters, like other things, sometimes went in and out of fashion. Not every one of, say, 300 station engineers in this country would risk acting on his own personal experience. There were a certain number of leaders, not officially appointed, who had confidence in themselves to initiate such fashions, and he felt certain that if they could gain some of them for the company again the rest would follow. They would have more chance to gain them if they could supply them with both large and small meters, and they would make every effort to do that so soon as the small meter was on the market. An effort was now being made to bring more life into the American business—the principal holders of the American Co. were at this moment in this country, and, considering negotiations were progressing at the moment, he hoped he might be forgiven if he did not refer to any details at the meeting, but he hoped to have good news when they met again. In conclusion, he said that while he was not by any means pleased with the result of the last year's working, and would not be pleased until they could pay regular dividends, and put every year a fair amount in reserve; nevertheless, what little satisfactory result had been achieved, had been achieved at great personal sacrifice on the part of many members of the staff.

Sir James Pender, Bart., seconded the motion, and the report was adopted.

Arc Lamps, Ltd.

The second annual report of the directors for the year ending July 31st, 1903, says that the gross profit for the period under review is £5,835, as compared with £3,989 for the year to July 31st, 1902, or an increase of nearly 50 per cent. After payment of all expenses of management, and after substantially depreciating machinery and plant, the surplus is £2,629 19s. 6d., which the directors regard as a very satisfactory increase over the result of the previous year's working. The W. J. Davy enclosed arc lamp has continued to increase in popularity, especially with engineers of corporations and borough councils. The business with the electrical trade has also been of the most progressive nature. The directors report that Mr. Davy has, as a result of extensive experiments, made important discoveries, and again added to the patents held by the company, but mention need only be made of the 1904 type of lamp, which is now being placed on the market, and the value of which it would be difficult to over-estimate. For the third time in the history of the company, it has become necessary, in order to cope with the increasing demand for the lamps, to extend the works, and negotiations are proceeding for the acquisition of the additional premises. Reference is made to the litigation with the Jandus Arc Lamp and Electric Light Co., Ltd. The directors declared an interim dividend at the rate of 5 per cent. per annum for the first half of the year to July 31st, 1903, and the shareholders were at yesterday's meeting asked to sanction a distribution at the rate of 7 per cent. per annum for the second half of the year.

India-Rubber, Gutta-Percha and Telegraph Works Co.

Major L. Darwin presided at the annual meeting of this company, held on Tuesday at the offices, 106, Cannon Street, S.E., and in moving the adoption of the report, a copy of which appeared in our last issue, he said that it was with great regret that he had to refer to the loss sustained by the death of Mr. Scott, who had first acted as one of the auditors of the company, and 20 years ago became a director. There were few remarks to make respecting the report, as the company was not at the moment engaged in any work of

great importance, and he could not prophesy as to what might be in store for them during the coming year. Since the last annual meeting they had received legal sanction to the amendment of the memorandum of association which was so much needed. The board had in preparation a new set of articles which would be more in accordance with the present want and practice; the articles were about 40 years old, and they had been altered from time to time in such a way that reference to them in their present state was very troublesome, and likely to cause misunderstandings and mistakes. The shareholders were to be congratulated upon the result of the year's working, as while paying the usual dividend of 10 per cent., they had written off buildings, machinery and ships, £46,150, or some £26,000 in excess of the usual annual depreciation. General business had fallen off in bulk as compared with last year, and competition had been keen. In one line, which was not an inconsiderable one, they had been beaten by German manufacturers, who, under the Kartel system which was in vogue among them, were selling far cheaper to English than to German trade. The board hoped to be able to recover this line by more economical production. The laying of the San Francisco cable was accomplished shortly after the company's meeting a year ago. That cable had continued to give every satisfaction to the Commercial Pacific Cable Co. The works were in an efficient state, but it would be necessary to make further additions to the plant if, as they anticipated, the new motor tire referred to in the report met with the approval of the motoring public. The chairman of the company (the Hon. Mr. Marsham) was on tour in Japan, and would doubtless make the company's name, and the nature of its manufactures, known in the districts he will visit. Mr. Moore, another director, was also returning to England after a time at Cape Town.

The report was unanimously adopted. The retiring directors and auditors were re-elected, and a vote of thanks closed the meeting.

The New Gutta-Percha Co.

The first annual report of the directors, to be submitted to the meeting to be held at Winchester House to-day, Friday, 18th inst., reads as follows:—

The past year has been occupied in preparations for the development of the company's business, including the selection of a suitable site for a factory (which was ultimately decided on at Greenwich); in adapting the existing buildings, and carrying out extensions of and additions thereto, and in obtaining and erecting the necessary plant and machinery. Considerable delay has been caused by the difficulty experienced in obtaining certain portions of the plant, and it was not until the month of September of this year that the work of erecting the plant and machinery and accessory apparatus was completed, so that the figures in the accounts presented do not represent the result of work on a commercial scale. The factory is now fully equipped for an output of about 1 ton of "new gutta" per day. In the design of the building and plant, provision has been made for future extensions, and the output of the works can be very substantially increased at a comparatively small outlay. It became evident to the directors at an early period that tests by independent authorities were absolutely essential in order to convince intending users that the "new gutta" could safely be employed as a substitute for the natural product, and to that end a length of submarine cable core, insulated with "new gutta," was submitted to Mr. James Swinburne, Past-President of the Institution of Electrical Engineers, &c., for test. A preliminary report on these tests has already been communicated to the shareholders, and it will be remembered that Mr. Swinburne was of opinion that the test should be continued for some months. Mr. Swinburne has completed his tests and is now preparing a final report which, the directors are pleased to state, is of a highly satisfactory character. Working samples of the material have been supplied to Government departments, to many of the larger railway companies and to other users. In each case the intending user asked for time in which to make his own tests. The distribution of these working samples has recently resulted in the receipt of firm orders for substantial supplies which the company is now proceeding to carry out, and the directors feel confident that in the ensuing year a large and remunerative business will be done. Mr. Adolf Gentzsch not having attended a board meeting for the last seven months, his seat on the board has become vacated under the provisions of the articles of association. He still, however, remains identified with the company, and his advice and assistance in all matters relating to the manufacture of the material are at the disposal of the board.

Nernst Electric Light, Ltd.

The fourth ordinary general meeting of the shareholders of this company was held on Tuesday at the Westminster Palace Hotel, Mr. Bernard M. Drake, M.I.E.E., presiding.

The Chairman, in proposing the adoption of the report, said that for the first time since the formation of the company they had made a profit during the past year. Having referred with regret to the resignation of Mr. Hugo Hirst, who, as a director, had rendered the company such valuable assistance in consummating the working arrangement which had resulted in that profit, he said that they had actually made a net profit of £3,926 for the year as against a debit of £3,157 for the previous year. The value of the patents had been left as before; neither had it been necessary to augment the suspense account as a result of the year's working. The directors' fees stood at the figure which the three directors had agreed to accept for the year; but as a new director had since been appointed, there were now four members, and, therefore, a proportionate increase for the year was proposed. The item included in the company's revenue for royalty on lamps sold in Great Britain was considerably in excess of last year's figure, but for trade considerations it was thought inadvisable to publish that as a separate item in the future. He was pleased to say that the working arrangement made with the Allgemeine Elektricitäts Gesellschaft had resulted in the continuance of friendly relations, and he was satisfied they were doing their very best to improve the quality of the lamps sent out. With regard to the progress of the lamp, the following extract from the last report of the A.E.G. would be of interest:—"The Nernst lamp, as regards its durability and the life of the burners has been further improved, and is showing good results, particularly on the higher voltage circuits so general now on modern installations. A new type of lamp for 250 candles, also a candle lamp, and lamps suitable for search-lights have been placed on the market. Up to now, approximately 2,000,000 lamps and burners have been sent out, and the demand is increasing." They had all doubtless by this time become familiar with the appearance of the Nernst lamp, which was largely used in almost every town in England. From their own districts some excellent reports had been received, and others were of a varying nature dependent largely upon the local skill obtainable and the regularity of the supply upon which lamps were used. There was no doubt that the lamp did consume about half the current required by carbon lamps for the production of an equivalent amount of light. On the other hand, like the Welsbach mantle, with which the Nernst lamp was so much associated in the minds of the earlier investors, it was a more delicate piece of apparatus than the ordinary lamp; hence it was more difficult to get to its destination, and required a skill in handling which was not always available. For the above reasons, they ought to appreciate that the original hopes formed at the time the invention was made, namely, that it would create a complete revolution in the industry, would not be realised by the lamp in its present form. It, however, fulfilled a most useful purpose, and he had little doubt that the sale would increase, especially in quarters where the generating stations had been well designed and the staff were possessed of good electrical knowledge. In view of the above they were again brought face to face with the difficult problem of the value at which the patents stood in the books. At the last annual meeting a provisional suggestion was made that the capital be reduced to £100,000, and although a circular was sent out on the basis of a reduction to £50,000, to meet the views of an important section, it remained for the shareholders with the knowledge now before them to decide which alternative they preferred. The result of the circular showed that only the holders of some 10,000 shares out of 320,000 were opposed to the scheme. On the other hand, a considerable number, as might have been expected, did not reply, and it was, therefore, impossible to say whether they could go to the courts as a united body with a request that they would grant them the reduction they desired. They had the best legal advice that they would be acting unwisely in adopting that course unless they were practically unanimous. Another course open to them was liquidation and reconstruction, which could be carried by a three-fourths majority, but if they could only agree, they should hope by the first process to effect their purpose by the expenditure of a few hundred pounds, whereas the second course would involve more than that sum in stamp duties and registration fees alone. On one point, however, there seemed to be no doubt, namely, that the directors would not, under existing circumstances, be justified in dividing any profits made until the losses of the past have been met. They, too, had not thought it worth while to deal with the question of depreciation while the more important consideration of the value of the patents was under discussion. Those losses, with the depreciation, which would have to be faced would mean that they must all wait some years before they could hope to receive any return on their money if they decided to leave things as they were. Personally, he should like to see the company put on a proper commercial footing without further delay, so that next year they might look forward to meeting them with a dividend to distribute.

Mr. J. G. Dalzell seconded the motion.

Mr. Scott took exception to the proposal to increase the amount to be divided among the directors, remarking that they had already taken £4,553, which, in his opinion, was quite enough.

The Chairman replied that, under the articles, the directors were allowed to draw up to £1,200 a year, but, as there had been no profits, they had made considerable concessions in the amounts they had taken. It was hardly reasonable that they should be asked to take the same amount for four as for three.

The report was then adopted.

Considerable discussion ensued on the question of the reduction of the capital, and eventually the following resolution was carried:—"It is resolved that the shareholders of this company desire that the capital of the company should be reduced to £100,000 in ordinary shares of £1 each of one class; that the preference shareholders shall receive as nearly as may be £75,000, and the ordinary shareholders £25,000, and that the directors be requested to take such steps as they may be advised are necessary for the reduction of the capital of the company on the basis of this resolution.

Isle of Thanet Electric Tramways and Lighting Co.

The report for the year ended September 30th shows a balance at the credit of profit and loss account of £12,304. The traffic receipts amounted to £33,465, as against £35,088 for the corresponding period of last year—a decrease of £1,623, which was entirely due to the inclemency of the weather during the past summer and autumn. To pay the debenture interest, dividend on preference shares, interest on loan, fees to debenture trustees, and income-tax, an additional sum of £3,403 was required, which has been taken from the unappropriated balance at the credit of last year's revenue account. From this balance also a sum of £1,853 has been written off for compensation for accidents and for other charges in the previous year. These were only ascertained after last year's accounts were closed, and the further sum of £500 has been written off "improvement of cars." The balance of last year's revenue account now stands at £5,047, which is carried forward. The company has been insured against accidents to third parties since June 16th, 1903. The supply of electric light to private consumers at Margate was commenced on January 2nd. Though the business was at first slow in developing, it is now showing indications of more rapid expansion both at Margate and Broadstairs.

Lord Arthur Butler (chairman) presided on Wednesday at Salisbury House, London Wall, over the ordinary general meeting of the shareholders of the above company, and in moving the adoption of the report, said no comparison could be made with the

figures of the previous balance-sheet as the revenue account which was last submitted embraced a period of 18 months. The past summer had been disastrous as regarded the receipts of an undertaking such as theirs, which mainly depended on the number of visitors attracted to the seaside towns in the Isle of Thanet. It was found that the difference between the receipts in a fine and wet week during the season would run into between £300 and £400. Proceeding to deal with the various items in the accounts, the chairman referred to the coal item, which seemed very heavy, but it had to be remembered that in addition to providing for the traction business they were also building up a growing lighting business. The items under the head of maintenance would always be large owing to the sharp curves and steep gradients. No depreciation fund had yet been formed, as the business was only in an early stage of development. When the district was more fully developed and a large revenue was being earned, it would be time to deal with depreciation fund. Owing to the poor results, the directors had waived a portion of their fees that year. The traffic receipts were certainly disappointing, owing solely to the bad weather, but under normal conditions they would have had a substantial increase of traffic. The lighting receipts were only in their infancy, and they were now putting down the mains in the Margate area, where they had a considerable demand for electric lighting, which should improve their receipts materially next year. In the balance-sheet there was an item of £40,000—"loans secured upon deposit of debenture stock." Owing to the great difficulty which would have been experienced in successfully placing on the market a further £50,000 of debentures, the directors arranged a temporary loan, and the money so obtained had been used in providing for the additional capital items which appeared in the balance-sheet. The accrued interest due on September 30th to debenture-holders and preference shareholders, had been provided for in the figures of £1,500 and £625, which appeared in the balance-sheet. They brought forward from last year's revenue account a sum of £10,804 14s. 5d., from which they deducted this year an amount of £1,853 7s. 9d., the bulk of which consisted of compensation for injuries and legal charges resulting from the unfortunate accident in August, 1901. The sum of £3,403 11s. 11d. had been carried to appropriation account for the balance of revenue account brought forward to meet the charges as set out in the appropriation account. This would leave a balance of £5,047 14s. 9d. to be carried forward to the credit of profit and loss account. In the financial year from October 1st to September 30th, the traffic receipts were £33,465, as against £35,088, and the passengers carried were 4,406,821, against 4,572,396.

Mr. A. WRIGHT seconded the motion, which, after some discussion, was agreed to.

Subsequently an extraordinary meeting of the company was held, when approval was given to the Bill being promoted in Parliament by the company for conferring powers on them to widen roads and acquire lands, &c.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—

Wednesday, December 23rd.—Metropolitan District Railway Co.—Partly-paid scrip of a further issue of £500,000 4 per cent. perpetual debenture stock.

Tuesday, December 29th.—Dick, Kerr & Co., Ltd.—52,000 ordinary shares of £5 each, fully paid, Nos. 1 to 52,000; 61,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 1 to 61,000; and £300,000 4½ per cent. debenture stock.

The Committee also ordered same to be quoted in the Official List, also the

British Columbia Electric Railway Co., Ltd.—Further issue of 1,500 5 per cent. cumulative perpetual preference shares of £10 each, fully paid, Nos. 51,001 to 52,500.

The Brazilian Mineral Syndicate, Ltd.—We understand that this company is being formed to work the mica deposits in Minas Geraes (Brazil). From a draft of the prospectus we learn that the nominal capital is £10,000, in £1 shares, and 4,700 of these shares are to be offered at par. The offices are at 29, Gt. St. Helens, E.C. (Mr. C. A. Sack, secretary).

Blackpool, St. Annes and Lytham Tramways Co.—The directors report that the doubling of the line and its equipment for overhead traction has resulted in satisfactory receipts. It is proposed to carry the balance of £2,017 forward.

Eastern Telegraph Co.—Interim dividend of 1¼ per cent. on the ordinary stock for quarter ended September 30th last.

R. Waygood & Co.—Warrants for the usual interim dividend at the rate of 5 per cent. per annum on the ordinary shares have been posted.

Cape Electric Tramways.—The directors have declared an interim dividend of 5 per cent.

Eastern Extension Telegraph Co.—Interim dividend for the quarter ended September 30th last of 2s. 6d. per share.

STOCKS AND SHARES.

Wednesday Evening.

BUSINESS in the Stock Exchange, if it shows no signs of expansion, is by no means as bad as it might be amongst the investment markets of the House, although the speculative departments are almost at a standstill. In these latter the holiday feeling has already put in an appearance, but the unusual ease, for the time of year, connected with the money market is all to the good of investment varieties. Movements in most of the stocks and shares quoted on the succeeding pages are narrow; an apparently startling fall in Brush second Debenture and a subsequent recovery being the principal feature of the week.

In the railway market Metropolitan and District stocks have quieted down a shade, prices continuing steady all the same. Metropolitans are being bought by an Anglo-American group, according to rumour, and in this connection it may be recalled that before the Yankees tackled District stock there were reports about their anxiety to control the Metropolitan Railway. Districts remain hard at 36, with London United Tramways shares at 11½. The London United Co. is giving notice that it intends to apply for powers to compulsorily acquire further land in the vicinity of Hammersmith Bridge, and the title of the Parliamentary Bill is to be the London United Tramways (Railways). None of the purely electrical railway stocks have moved.

With a certain weariness, we again lift up a note of warning to those who are being asked to find more money for the National Electric Traction Co., Ltd., the concern that arose out of the ashes of the British Electric Street Tramways, Ltd., which went into voluntary liquidation. As an inducement to subscribe further capital, the National Electric Traction proprietors are offered a few fully paid shares if they will take up others with 15s. paid. Those who have good money to throw after bad have thus another chance of wasting their substance.

British Electric Traction Ordinary have lost the rise of ¼ that they made last week, but the Traction market, as a whole, is good. Anglo-Argentines rose smartly to 4⅞, and City of Buenos Ayres Trams to 9 upon the amalgamation proposals. The 6 per cent. permanent Debenture stocks of both undertakings stand about 130. Buenos Ayres and Belgranos fell ⅛ to 3, and Calcuttas are being done about 7. London United Ordinary are 18½.

Upon the fresh capital powers now being sought, Edmundsons Ordinary fell ¼ to 6½, and Brompton Ordinary have receded a similar fraction. Westminsters are picking up, and record a 10s. rise, thanks to the attention directed to them as a probably improving investment. Metropolitans are ½ lower. One or two of the Debentures in the Electricity Supply list have been marked *ex* interest, but the outstanding item of interest is the extraordinary manœuvres in Brush Second Debenture stock. Last Monday the price in the morning stood at 84—89, as it has done for some time past; in the afternoon a bargain was marked at 65! A seller came in, could get no better bid, and therefore sold his stock for that figure. On Tuesday there was electricity in the air. It is said that a gentleman not unconnected with lighting and tramway enterprise hastened down to the City, and, after strong representations, the quotation was put up to 78—85, the seller of Monday receiving a very unexpected addition to his price. There is accordingly a drop of 6½ points on the week. The incident serves to show the purely nominal character of too many quotations; but it must be admitted that, if there is no business to test a price, it is difficult to see how such things can be entirely avoided. Such support is not always forthcoming.

Edison & Swan "A" shares, £5 paid, have been lowered 10s. to £1 as the middle price, while Electric Constructions are ¼ better at 1¾, the Debenture stock also hardening. Electric and General Investment Preference shares remain at 5, unaffected by the declaration of a dividend at the rate of 10 per cent. on the Ordinary, in which there is no market. Several of the low-priced electrical varieties are being inquired for, Aron Meters, for instance. Instead of being unsaleable at 6d. each, as they were a few weeks back, they are now up to 2s., and the Preference 5s. Nernst are also a few pence better at 1s. 6d., the Preference being 5s. too. In each of these cases the speculative investor has been picking up shares upon the recently-issued reports.

Telegraph stocks and shares have had another quiet week. Anglo-American Deferred has moved the usual 5s.; this time it is a rise. The market are guessing the dividend on this stock at anything between 1s. and 5s., the announcement being expected about a month hence. None of the Eastern descriptions have changed, despite the business that the Australian cricket matches should be bringing. In which connection it may be incidentally mentioned that Mr. R. E. Foster, the hero of this week's test match, is a member of the Stock Exchange. West India and Panama show a little tendency to recover: the second Preference has risen 10s., although the Ordinary are ⅛ lower.

None of the National Telephone issues fluctuated, and the only quotable alteration in this department is a slight rise in Oriental Telephone shares, bringing the price of ⅛ middle.

Nothing definite has been heard of that dividend on British Westinghouse Preference, the delay in whose announcement is responsible for the flatness of the price at 4⅜. Report says that there are divided counsels on the Board as to the advisability of paying the dividend, and that certain interests strongly oppose a distribution. If the dividend should have to be passed, a very severe blow will be dealt to the credit of these half-English and half-American combinations.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Dec. 9th.	Closing Quotations Dec. 16th.	Business done week ended Dec. 16th, 1903. Highest	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —103	99 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3¼	2¼— 3¼	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,350 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	49 — 52	49 — 52	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	92 — 94	93⅜	92⅝
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	7⅛— 8	7⅜— 8⅛	7 13/16	7 11/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	5 %	4⅜— 5⅛	4⅜— 5⅛	..	..
18,888,800$	Commercial Cable	$100	8 %	8 %	8 %	145 —155	145 —155	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock				90 — 93	90 — 93	..	..
16,000	Cuba Telegraph	10	4½%	4 %	6⅜%	7 — 8	7 — 8	7⅞	..
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	16 — 17	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101	97 —101	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10¼	10 — 10⅜	10¼	10⅛
37,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	122 —127	122 —127	125	122
1,955,555	Do. 5½ % Pref. Stock	100	..	..	..	85 — 88	85 — 88	87½	87½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —109	105 —109	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11 — 11½	11 — 11½	11¼	..
890,000£	Do. 4 % Deb. Stock	Stock				106 —109	106 —109	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	6½%	5½%	..	8¼— 8¾	8¼— 8¾	8⅝	8 7/8
180,042	Do. do. 6 % Pref.	10	..	..	..	12½— 13	12½— 13	12 13/16	12¾
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	25 — 26	25 — 26	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	37 — 40	37 — 40	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	98 —102	98 —102	..	..
1,988,393	National Telephone, Pref. Stock	100	5 %	5 %	6 %	101 —103	101 —103	102⅛	102
1,966,667	Do. do. Def. Stock	100	..	..	4½%	78 — 81	78 — 81	80½	79½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96 — 98	97⅛	98
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	102 —104	102 —104	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	.. — ..	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7⅛	6½— 7⅛	..	..
3,808	Submarine Cables Trust	Certs.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5⅝— 6	5⅝— 6	5 13/16	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞— 5⅛	4⅞— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100				95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	11¾— 12¼	11¾— 12¼	12⅛	..
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	99 —102	..	..
88,821	West India and Panama Telegraph	10	2½%	..	..	7/16— ½	⅜— ½	..	..
84,553	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6¼	6 — 6¼	6 7/16	6 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4 — 5	4½— 5½	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	101 —104	101 —104	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

30,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4½— 5⅜	4½— 5⅜	4 13/16	4 9/16
200,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	89 — 92	88 — 92	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11½— 12½	11¼— 12 xd	12	11¼
100,000	Do. do. 6 % Cum. Pref.	£10	..	..	..	11½— 11⅝	11⅛— 11⅝	11 11/16	11¼
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock				120 —123	120 —123	..	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6 — 6¼	6 — 6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5⅜	5¼— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	103 —108	103 —108	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	⅞— 1 1/16	⅞— 1 1/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1⅜— 1½	1⅜— 1½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1½— 1⅝	1½— 1⅝	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	84 — 89	78 — 85	65	..
85,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11 — 12	11 — 12	11⅜	11⅛
40,000	Do. do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,960,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	93 — 96	93 — 96	93½	..
494,098	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	99 —102	99 —102	..	..
494,998	Do. do. Def. do.	Stock	..	4 %	4 %	96 — 99	96 — 99	..	..
1,980,000	City and South London Railway	Stock	1½%	2 %	3½%	47 — 50	47 — 50	48	47
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	5 %	1⅜— 2¼	1⅜— 2¼	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	99 —103	99 —103	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	2½%	Nil	..	0 — ⅛	0 — ⅛	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1 — 2	⅛— 1½	1	..
344,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅝— 1⅞	1⅝— 1⅞	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¾— 3	2¾— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	98 —101	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9¾— 10¼	9¾— 10⅛	9¾	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	96 — 99	96 — 99	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5⅛	5 — 5⅛	..	..
48,060	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	10 %	18½— 19½	18½— 19½	..	..
200,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —108	100 —108	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	4½— 5	5⅛— 5⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 10⅝	10½— 10⅝	..	..
37,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	34 — 37	34 — 37	35½	35
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	91 — 94	91 — 94	93	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Dec. 9th.	Closing Quotations Dec. 16th.	Business done week ended Dec. 16th, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡ 1	..	..	..	5/8 — 7/8	5/8 — 7/8	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	116 —119	116 —119	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	6 %	8 %	8 %	10½— 10⅝	10½ — 10⅝	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10½— 10⅝	10 — 10⅛	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	10 — 10⅛	8⅞ — 9⅛	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛— 5⅜	5⅛ — 5⅜	5⅛	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅛— 5	4⅛ — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	105 —107	103 —105 xd	..	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5½ — 6	5⅛ — 6	..	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10 — 10½	10⅛ — 11	10½	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	13⅜	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	122 —127	122 —127	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000. .	10	4 %	4 %	4 %	7⅞— 8⅛	7⅞ — 8⅛	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000. .	10	..	..	..	11⅞— 12⅛	11⅞ — 12⅛	..	..
400,000	Do. do. 4½% Deb. Stock	..	..	..	..	108 —111	108 —111	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
60,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6⅛— 6⅜	6 — 6⅛	6 7/16	6 5/16
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6⅛	6 — 6⅛	6 7/16	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	104 —107	104 —107	105½	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11½	10½ — 11½	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	101 —104	101 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞— 2⅛	1⅞ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	5 3/16	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	98 —101	97 —100 xd	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17⅜— 18⅛	17 — 18	18⅛	17⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	4⅛— 4⅜	4⅛ — 4⅜	4⅜	..
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —114	110 —114	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	12⅜— 13½	12⅜ — 13½	13½	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14⅜— 15⅝	14⅜ — 15⅝	15	14⅝
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	7⅞ — 8⅛	7⅞ - 8⅛	8⅛	..
150,000	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3⅛	3 — 3⅛	3⅛	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	— —	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3⅛— 3⅜	3⅛ — 3⅜	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅛— 5⅛	4⅛ — 5⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅛— 5⅛	4⅛ — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	11⅛— 12⅛	12 — 13	12⅝	12⅛
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	..	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, December 16th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
	,, ,, ...	per ton	£30	..
	Bleaching powder	per ton	£4 10	..
	Bisulphide of Carbon	per ton	£15	..
	Borax	per ton	£13	..
	Benzole (90 %)	per gal.	7/-	..
	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£20	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	,, Caustic (75/80%).. ..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	236/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£48 to £130	..
e	Brass (rolled metal 2' to 12') basis	per lb.	6¾d.	..
e	,, Tube (brazed)	per lb.	8¾d.	..
e	,, ,, (solid drawn).. ..	per lb.	7¼d.	..
e	,, Wire, basis..	per lb.	7d.	..
c	Copper Tubes (brazed)	per lb.	9¼d.	..
e	,, ,, (solid drawn) ..	per lb.	9½d.	..
g	Copper Bars (best selected ..	per ton	£71	..

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£71	..
g	,, Rod	per ton	£71	..
e	,, (Electrolytic) Bars ..	per ton	£63	..
e	,, ,, Sheets ..	per ton	£78	..
e	,, ,, Rod	per ton	£75	..
e	,, ,, H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	3/3	..
f	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	3/-	..
h	India-rubber, Para fine	per lb.	3/11 to 4/0½	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	41/6	..
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 12 6 to £11 15	5s. inc.
g	,, ,, Sheet	per ton	£18	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 5	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	,, ,, ,, medium	per lb.	2/6 to 3/9	..
d	,, ,, ,, large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/- to 1/3	..
p	,, ,, strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£131 to £132	£5 inc.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/8	1½d. inc.
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5⅝d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4⅛d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Dec. 12	1,079	+270	34,896	+ 6,026	10	—
	Birmingham	,, 12	4,894	+342	253,984	+10,058	—	—
	Bournemouth	,, 9	770	—	—	—	10½	—
	Blackburn	,, 11	787	+139	31,709	+ 1,030	13½	—
	Blackpool	,, 10	254	+ 26	37,053	— 158	8½	—
	Blackpool and Fleetwood	,, 12	169	+ 17	20,375	— 108	7½	—
	Blackpool and Lytham ..	,, 10	128	+ 22	860	+ 429	7½	—
	Bolton	,, 13	1,660	+201	68,207	+ 8,159	25	—
	Bradford	—	—	—	—	—	41	+4
	Brighton	,, 13	721	+ 93	34,657	—	7½	—
	Bristol	,, 11	4,809	+477	—	—	28	—
	Burnley	,, 12	746	+118	—	—	7½	—
British Elec. Trac. Co.	Barnsley District ..	,, 4	152	+ 19	8,701	— 2	4½	—
	Devonport	,, 4	420	+ 51	22,630	+ 1,463	5	—
	Dudley—Stourbridge..	,, 4	732	+ 33	40,434	+ 3,759	18½	—
	Gateshead	,, 4	834	+ 15	42,103	+ 5,867	10½	+ ½
	Gravesend—Northfleet	,, 4	188	+ 29	11,687	+ 1,245	3½	—
	Greenock—Pt. Glasgow	,, 4	438	+ 14	26,446	+ 2,152	7½	—
	Hartlepool	,, 4	235	+ 31	13,104	+ 855	6½	+2
	Kidderminster	,, 4	99	+ 8	6,175	+ 176	4½	—
	Merthyr	,, 4	182	+ 19	9,683	— 7	3	—
	Middleton	,, 4	235	+ 27	15,393	+ 1,868	8½	—
	Oldham—Ashton ..	,, 4	494	+ 12	27,502	+ 1,601	8	—
	Peterborough	,, 4	105	—	7,103	—	4	—
	Poole	,, 4	199	+ 8	14,623	+ 2,084	22	—
	Potteries	,, 4	1,648	+ 67	76,867	+ 3,554	28½	—
	Southport	,, 4	245	+ 30	15,174	+ 2,648	5½	—
	South Staffordshire ..	,, 4	951	+363	44,501	+ 8,019	21½	—
	Swansea	,, 4	482	+ 68	25,127	+ 2,113	5½	—

* Compared with the corresponding period of 1902.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	B.E.T. Co. *continued.*							
	Tynemouth	Dec. 4	175	— 17	15,045	+ 764	3½	—
	Wolverhampton Dist.	,, 4	326	+ 28	18,849	+ 7,674	10½	+8
	Wrexham	,, 4	109	—	4,914	—	—	—
	Yorks. Woollen Dist...	,, 4	485	—	16,157	—	6	—
	Cardiff	,, 12	1,813	+467	72,978	+19,911	14	—
	Chatham & District Co.	,, 10	486	+197	26,471	+14,058	8·53	—
	Cork	,, 10	385	+ 37	25,409	— 3,368	9	—
	Dover	,, 12	176	+ 27	10,895	+ 82	3½	—
	Dublin	,, 11	4,344	+421	121,517	+ 8,181	46½	+ ½
	East Ham	,, 12	563	+152	24,953	+ 7,331	5	+ ½
	Glasgow	,, 12	13,582	+3066	383,044	+40,188	69½	+7½
	Halifax (two weeks) ..	,, 2	2,158	+195	49,183	+ 5,531	31½	+1½
	Hull	,, 12	1,822	+209	69,295	+ 4,066	11½	+1
	Ilkeston	,, 9	111	—	—	—	4	—
	Isle of Thanet	,, 12	213	+ 10	32,735	— 1,569	10½	—
	Leeds	,, 12	4,929	+430	204,877	+12,604	41	—
	Liverpool	,, 5	9,317	+285	492,774	+16,255	108	—
	London County Council	,, 5	8,272	+1384	357,053	+66,447	39½	—
	Manchester	,, 12	10,737	+3287	432,686	+253,534	72	—
	Newcastle	,, 12	3,433	+50s	—	—	17	—
	Portsmouth	,, 12	1,287	+227	67,276	+ 4,177	14½	—
	Salford	,, 7	3,464	+767	138,040	+40,788	30	—
	Southampton	,, 10	861	+126	—	—	16½	—
	Southend-on-Sea	,, 9	181	+ 39	12,421	+ 1,999	8	—
	Sunderland	,, 13	998	+ 26	45,780	+ 2,163	20	+3
	Central London Railway	,, 12	7,054	—275	153,154	— 7,185	6	—
	City and S. London Ry.	,, 13	3,458	—419	64,645	— 9,809	6½	—
	Dublin and Lucan Rlwy.	,, 13	82	+ 7	3,022	+ 180	6½	—
	Liverpool Overhead Ry.	,, 13	1,512	+143	39,762	+ 2,605	6½	—

THE BRITISH ASSOCIATION, SOUTHPORT, 1903.

THE RESISTANCE OF ROAD VEHICLES TO TRACTION.

(*Concluded from page* 966.)

Effect of the Nature of the Tires.

The experiments of M. Michelin have shown that the tractional resistance is reduced from 15 per cent. to 30 per cent., according to the nature of the road, by the use of pneumatic tires in place of metal tires. He explains this by the well-known saying, "Le pneu boit l'obstacle." Baron de Mauni, in a recent work, has given an account of some experiments which he made on different tires, particularly pneumatics. He showed that if two wheels with tires of equal widths supported equal loads, the one that has the greater arc of contact with the ground will travel better than the other. With a rigid tire, such extended contact can only be secured by increasing the diameter of the wheel, which is impossible beyond certain limits, so that the tire will sink into the ground by an amount proportional to the weight carried. With rubber tires the increased area of contact is due to the elasticity of the material and not to the increased diameter, so that the wheel does not sink into the road.

Prof. Baker's experiments seem to show that on good roads the width of tire has little effect on the resistance, and that even on bad roads the advantage lies sometimes with the wide tires and sometimes with the narrow ones, according to circumstances. Arguments have been advanced in favour of both wide and narrow tires, but nothing very definite seems to be known on the subject; according to M. Michelin, if we reduce the width of the tire we reduce the adhesion to the ground, which is already little enough. As a case in point, he mentions that M. Serpollet, in order to attain a speed of 120 kilometres (75 miles) per hour on the Promenade des Anglais in 1902, had to deflate his tires, and thus get a larger surface of contact with the ground. Besides, in order to get a narrow tread it is necessary to give to the tire a form other than circular, and this shape can only be retained at the expense of its flexibility. Consequently a tire of this description will be subjected to greater internal friction in its fabric than one naturally circular in section, and the energy wasted will therefore be greater.

The whole question, however, is very much open to discussion, and the present Congress may offer to the opposing schools an opportunity of coming to some understanding.

Resistance of the Air.—Study of Forms to Diminish this Resistance.

The air resistance is a retarding force of the highest importance, especially where speed is concerned, and there is unfortunately great uncertainty both as to the formulæ to be applied, and the values of the coefficients which appear in them.

The best-known formula is

$$R = KSV^2,$$

in which R equals resistance in kilogrammes.

S equals projected area in square metres of total surface of vehicle on a plane normal to the direction of motion.

V equals velocity in metres per second.

K a numerical coefficient which varies between very wide limits, according to the form and the speed of the vehicle.

The formula by M. Desdouits, $R = KV$, is sometimes preferred, as it is more correct for high speeds.

The different values given to K in the first formula may be due to the varied conditions under which the experiments were made.

Signor Canovetti had made some experiments at Zossen to determine the value of K. He had a copper wire, 380 metres long, stretched between the summit of the fortifications at Brescia and a point in the plain, about 70 metres below. Along this wire different surfaces were allowed to descend freely. A circle, with a surface of 0·073 sq. metre, moving with a velocity of 12 metres per second, gave a resistance of 84 grammes. The same circle, having a spherical cap in front, offered a resistance of only 21 grammes. When this hemisphere was followed by a cone, whose height was five times its diameter, the resistance fell to 13 grammes, or one-sixth of that of the plane circle. With this same solid, turned the other way about—that is, with the apex of the cone towards the direction of motion—the resistance rose to 18 grammes.

Signor Canovetti has recognised that a rectangular surface, placed with its long sides horizontal, offers a sensibly greater resistance to the air than when its short sides are horizontal. His experiments seem to show that the coefficient K diminishes somewhat as the speed increases, but investigations carried out at Zossen point to the conclusion that the resistance may increase tenfold when the velocity is only tripled. It is thus clear that air resistance is a matter of no small importance when speeds up to 60 or 80 miles an hour are attained. At 85 kilometres (53 miles) per hour, the energy required to overcome the air resistance on a vehicle, with an opposing surface of 1 sq. m. (1,550 sq. in.), may be 7, 11, or 20 H.P., according to the coefficient K given as 0·0288, 0·0648, or 0·116 by MM. Forestier, Bourlet, or Thibault.

The question then arises, What is the best shape for a car? The answer depends upon several things—as, for example, the necessity of placing the radiator in such a position that it may be efficiently cooled by the air rushing through it. Only general principles may be laid down. The front of the car ought to taper, and the back be more pointed still, like the form of a fish: transverse rectangular surfaces that cannot be dispensed with, should, as far as possible, have the longer sides vertical; and it is as well to have doors on the car to prevent the air from rushing in between the dashboard and the seat.

These conditions are quite neglected in most of the present-day cars. Particularly is this the case in the "Coffin Head," that unlovely affair so much in vogue—a flat surface directly opposed to the air pressure. With a radiator of the honeycomb type, a transverse position is necessary for cooling purposes, and Signor Canovetti has shown evidence that a perforated surface will offer less resistance to the air than a plane one of a similar area. It is not of much advantage with an automobile, as the air, after having passed through the holes in the radiator, meets with further obstacles in the mechanism inside the hood.

With regard to the working parts situated under the car, these should be made by the aid of inclined planes to cut the air rather than oppose it.

M. Lavergne commends the suggestion of M. Forestier that different-shaped bodies should be mounted on an electric chassis, and the total resistance of chassis and body accurately measured, so that a really practical model could be designed.

Power Required by Automobiles.

Under this heading, M. Lavergne has shown the enormous reduction of weight per horse-power that has taken place during the last eight years. In 1895, Levassor made the run from Paris to Bordeaux in a 4-H.P. car weighing about 1 ton, or 1 H.P. per 550 lbs. dead weight. In 1896 this weight was reduced to 365 lbs. per horse-power; in 1900 it fell to 90 lbs. per horse-power. In the recent Paris-Madrid race, M. Gobron Brillie appeared with a 100-H.P. car, the weight of which represented only 22 lbs. per horse-power. This weight has been still further reduced in the case of motor bicycles, reaching as low a figure as 17·5 lbs. per horse-power.

But there is not a corresponding increase in speed. In 1901 M. Fournier made over 53 miles per hour with a 28-H.P. Mors; last year M. de Knyff only slightly exceeded 58½ miles per hour with a 70-H.P. motor; that is, an additional 40 H.P.

To what must this relatively small increase of speed be attributed? Air resistance is responsible for some increase but certainly not all.

An extremely powerful motor must be accompanied by a comparatively heavy load, otherwise the wheels do not "bite" well and energy is wasted. It is well known that the modern racing-car skims along the surface of the course, without sufficiently close contact between the wheels and the ground; in any case driving wheels should be more heavily weighted and springs made less elastic. To reduce the power lost in vibration, the engine should be more perfectly balanced, and, if necessary, the fly-wheel and motor itself made heavier. "Who shall say," M. Lavergne concludes, "whether, instead of building very powerful yet extremely light motors—the durability of which is questionable—it would not be better to rest content with a vehicle of smaller power, and use it more effectively?"

IV.—*Negotiations with the War Office.*

At a committee meeting held at the Society of Arts on May 15th, 1903, it was proposed that as the expenses of this research were extremely heavy it would be advisable to approach the Mechanical Transport Committee of the War Office, in order to see if they would conduct the experiments with heavy traction, as they had at their command various powerful motors and traction engines, together with the necessary variety of wheels. The Transport Committee in return would have the use of the British Association recording instruments for their own experiments.

This British Association Committee would have access to the information obtained which was of a scientific character with a view to publication, but it would not concern itself with data relating to the actual wagons and other matters of a purely military character.

As a result, the Transport Committee replied favourably, and arrangements, it is hoped, will now be made by which important work will be carried on by that Committee, thereby avoiding the very heavy expense to meet which it is difficult to raise funds from private sources.

INSTITUTION OF ELECTRICAL ENGINEERS.

PROCEEDINGS OF DECEMBER 10th, 1903.

THE meeting of the Institution held on Thursday, 10th inst., may justly be regarded as of historic interest, in that after a lapse of 300 years from his death, the merits of the founder of modern electrical science and of the allied science of terrestrial magnetism, Dr. Gilbert, of Colchester, received a worthy recognition at the hands of the accredited representatives of modern electrical work in Britain. It is also a matter for congratulation that the recognition took such a suitable form as Mr. Ackland Hunt's fine picture, which will find its future home in the Colchester Town Hall. And further, to step from the past into the present, which is perhaps of more moment to electrical engineers in this country, the electrical interests of two neighbouring nations can only benefit from the visit of Mons. Hospitalier, the President of the French Society of Electricians, and the paper which he so heroically delivered, despite the several adverse conditions. That both Mons. Hospitalier's efforts and his ingenious apparatus were fully appreciated, his audience demonstrated in no uncertain manner.

In connection with the presentation, there were present the Mayor (Mr. S. H. Barritt), town clerk (Mr. H. S. Franklyn), and several members of the Corporation of Colchester. The Mayor of Westminster Sir Dyce Duckworth, M.D., treasurer of the Royal

College of Physicians; Dr. Larmor, F.R.S., St. John's College, Cambridge; Sir Wm. Huggins, President of the Royal Society; and many of the more prominent members of the Institution.

The President of the Institution, Mr. Gray, in opening the proceedings, briefly mentioned the event which had brought them together that evening. He deputed to Dr. Silvanus P. Thompson the task of enlightening those present as to the circumstances of the present commemoration.

Dr. Silvanus Thompson, F.R.S., in an excellent little speech, disclosed to his hearers the notable features and qualities which distinguished the life of Dr. Gilbert. He pointed out the many famous men who lived in Queen Elizabeth's time, and that of all of them Gilbert stood pre-eminent, for he was the first electrician. In addition to being the founder of that science, he also claimed admiration as the founder of terrestrial magnetism, upon which he is recorded to have spent a considerable fortune. He first propounded the fact that the earth was a magnet, and he also made known the qualities of amber. In connection with astronomy, he produced the first map, before the advent of the telescope.

Dr. Thompson briefly touched on Gilbert's connection with St. John's College, Cambridge, of which he was a Fellow, and welcomed the representatives of the scientific societies who were present. He concluded by a short reference to Gilbert's connection with Colchester, and expressed the hope that many of them would have an opportunity of visiting that town.

The President then, in the name of the Institution, asked the Mayor to accept and keep for the town and Corporation the picture, which was painted by Mr. Ackland Hunt, and exhibited in the Manchester Exhibition in 1876.

The picture represents Dr. Gilbert, the then President of the Royal College of Physicians, exhibiting some electrical experiments before Queen Elizabeth. It was purchased from funds resulting from a private subscription made during this year.

The Mayor of Colchester, in accepting the picture, thanked the Institution in the name of the town. His electrical reminiscences must have reminded his hearers of their very early experiences in that line.

The Mayor of Westminster and Sir Dyce Duckworth then spoke briefly, the latter paying a tribute to Dr. Thompson's research work in connection with Gilbert.

Mons. E. Hospitalier (Foreign Member) then read his paper on "The Slow Registration of Rapid Phenomena by Strobographic Methods," an abstract of which follows:—

THE ONDOGRAPH.

[The beautiful instrument which Mons. Hospitalier placed before the Institution on Thursday last week, is already familiar to our readers, thanks to the articles on the Ondograph contributed to our pages in June last by Mons. Hospitalier himself.* A detailed description of the instrument has, therefore, been here omitted.—Eds. Elec. Rev.]

The Ondograph belongs to the class of strobographs—apparatus employed to record phenomena by utilising the principle of the stroboscope. It consists of a synchronous A.C. motor actuated directly by the source of electrical energy under observation; a train of gearing giving to a revolving contact-maker a speed very

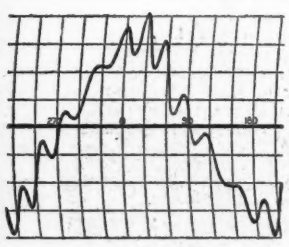


Fig. 5.

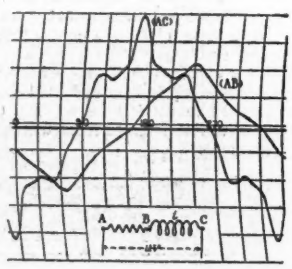


Fig 8.

slightly greater or less than that of the motor or a multiple of the latter; the contact maker aforesaid, which places a condenser successively in connection with two points in the circuit under test and with a measuring apparatus; a condenser, the capacity of which can be regulated at will; and a recording measuring apparatus.

The motor is synchronised by hand, and runs with 110 volts at frequencies between 25 and 100 periods per second. The gearing is so designed that when the motor has made $\frac{n}{2}$ revolutions, corresponding to n periods, the commutator will have made only $\frac{n-1}{2}$ revolutions, with a uniform retardation. The recording cylinder makes one complete revolution for every three periods; each of the three curves registered corresponds to 1,000 periods and 999 impulses. One complete period takes up a length of 96 mm. on the cylinder, the amplitude being made to vary at will between 10 and 50 mm. As one complete revolution of the cylinder corresponds to exactly 3,000 periods, by measuring the time occupied in its rotation the frequency can be accurately measured.

To avoid the inconveniences arising from the use of a short pointer, as is usual, on the recording cylinder, the author uses a separate pointer, 36 cm. in length, the end of which describes

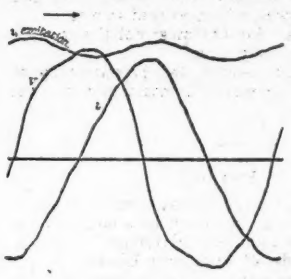


Fig. 9.

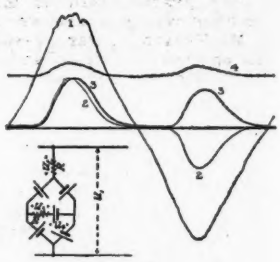


Fig. 20.

almost a straight line; this is controlled by the actual pointer attached to the measuring instrument. The ondograph, with slight modifications, can be applied to recording not only periodically varying phenomena, but also phenomena of short duration, such as the oscillatory discharge of a condenser through a self-induction.

Fig. 10.

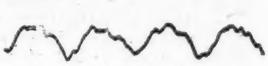


Fig. 12.

In the Differential Ondograph the period of registration is independent of the frequency, and the drum registers only two periods, each 144 mm. long. Normally the motor drives the commutator at synchronous speed, but by the interpolation of a differential gear, the speed of the commutator can be retarded at will. Thus the record can be produced as slowly as may be required.

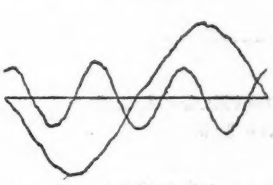


Fig. 16.

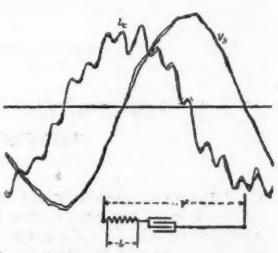


Fig. 13.

The *Puissance-Graphe* (Power-Recorder) consists of an Ondograph in which the moving-coil galvanometer has been replaced by a Thomson meter, specially arranged as a wattmeter. By means of this instrument the author has been able to record the waves of pressure, current and power in an A.C. circuit on a single sheet of paper.

To illustrate the applications of the Ondograph a number of examples were given, of which we reproduce a selection herewith.

Fig. 5.—Alternator working on cable mains. Kilowatts = 220. Amperes = 110. Cos ϕ = 0·66.

Fig. 8.—Monocyclic alternator working on a self-induction. A C, difference of potential. A B, current in the self-induction.

Fig. 9.—Siemens alternator (armature without iron) supplying an inductive circuit. Potential difference (v) = 112 volts; current (i) = 16 amperes. Self-induction (air-core) = 0·0175 henry; resistance = 0·6 ohm. Frequency = 50 cycles per second. Machine excited from accumulators without any resistance in series; exciting current = 23 amperes; resistance of circuit = 0·4 ohm. The diagram shows the reaction of the armature current on the exciting current (i_1).

Fig. 10.—Difference of potential between the terminals of a two-phase Alioth rotary converter on open circuit. Curve repeated five times.

Fig. 12.—Current given by Brush machine (old type) supplying arc lamps. Ondograph driven direct from machine by flexible shaft.

Fig. 13.—Charging of a condenser, showing the presence of the 15th harmonic. Capacity = 16 mfd. Potential difference = 110 volts. Resistance in circuit = 20 ohms.

Fig. 16.—Resonance of third harmonic. Capacity = 2·45 mfd. Resistance = 6 ohms. Self-induction = 0·76 henry. Frequency = 40·4 cycles per second.

* "Mons. Hospitalier's Ondograph," Electrical Review, Vol. 50 June 13th and 20th, 1902.

Fig. 20.—Nodon valve connected up as a Wheatstone bridge, charging accumulators. 1 = potential difference of supply. 2 = current. 3 = current rectified. 4 = potential difference of accumulators. R.M.S. current = 11 amperes. Mean current rectified = 9 amperes.

Mr. Duddell, in response to an invitation by the President, thanked Mons. Hospitalier for his efforts on their behalf. He had never seen an apparatus of that nature, which worked so well.

Prof. Ayrton added his thanks for the most delighting, nay, exciting evening, experienced for a long time.

Mr. Gerald Stoney appeared to question the practicability of the apparatus; he wanted something which he could put into the hands of his test-house staff.

Dublin Local Section.

At a meeting of the Section held on Thursday, 10th inst., at the University College, Dublin, a lecture, illustrated by a large number of experiments, was delivered by the Very Reverend Monsignor Molloy on "An Experimental Study of Stationary Electric Waves, with Special reference to the Phenomena of Electric Resonance and Overtones."

The lecturer pointed out the close analogy between the resonance of an electric circuit and the resonance of an organ pipe. The apparatus consisted of a pair of Leyden jars, which could be joined in series or parallel, as desired, and an adjustable self-induction, by means of which the period of an oscillating discharge between two zinc balls could be varied at will. The jars were charged by means of a powerful induction coil. The resonating electric circuit consisted of a wire wound round a vertical rod, one end of the wire terminating in a ball mounted on the top of the rod, the other end being attached to the inner coating of one of the Leyden jars.

When the period of the oscillating discharge was made the same as the natural period of the wire, brush discharges and sparks issued from the knob attached to the free end of the wire and vacuum tubes held near it were lit up.

The possibility of operating two different wireless telegraph circuits simultaneously and independently by means of resonance was very prettily shown, by using pairs of circuits of the same period as sender and receiver, each pair being tuned to a different pitch; the signals were made visible by means of a vacuum tube, placed near the free ends of the receiving wires. In order to show overtones a long rod some 10 ft. in height was overwound with a considerable length of wire. The oscillating circuit attached to the lower point of this wire was then adjusted to give first the fundamental and then the harmonics of the wire, the electrical oscillations being made visible by the brush discharges between the rod and a fine vertical wire connected to earth and stretched parallel to the rod at a distance of about 2 in., also by moving a vacuum tube up and down beside the column.

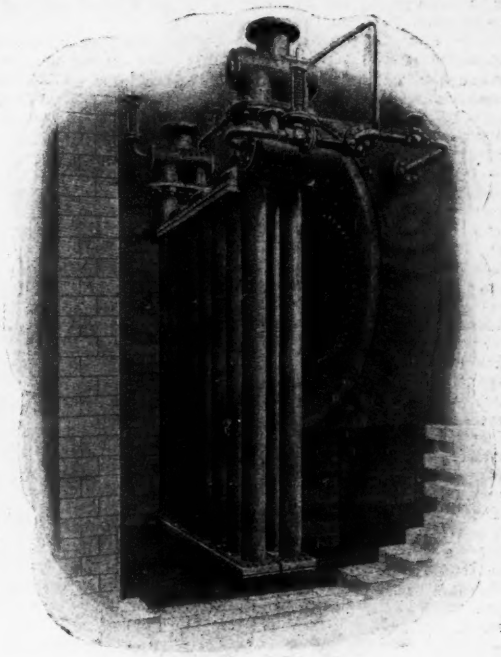
A hearty vote of thanks was passed to Monsignor Molloy at the close of the lecture.

THE CRUSE CONTROLLABLE SUPERHEATER.

A paper on superheated steam in general, and the Cruse controllable superheater in particular, was read before the Scientific Society, Glasgow, by Mr. W. H. Booth on the 5th inst. It was pointed out that superheated steam could not be dealt with on thermodynamic lines. It possessed more heat per pound than did saturated steam, but it had considerably less heat per cubic foot, and a heat engine did work by reason of heat, and required as much heat per unit volume as it could secure if its bulk as a machine was to be kept within commercial dimensions.

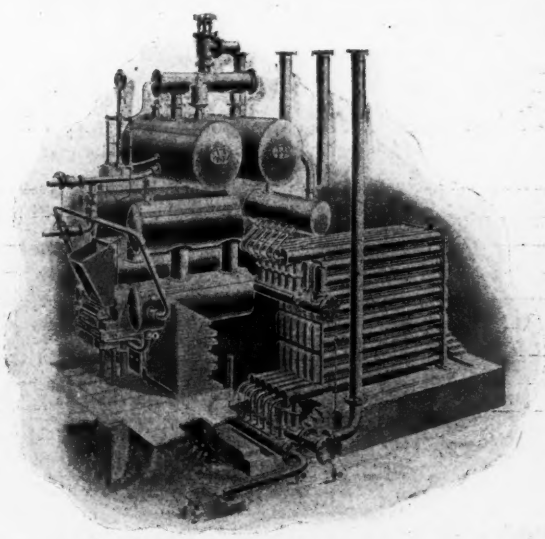
What was really wanted in a steam engine was dry saturated steam, and the office of superheat was, by sacrificing its existence, to maintain an even temperature in the metals, and by effacing itself in the inevitable radiatory action to give this dry saturated condition at cut-off, when, per unit of cylinder volume, the maximum amount of heat was present in the cylinder. Superheat had been subjected to all kinds of misconceptions, but if it were only clearly understood that its duty lay in combatting the evil effects of pipe radiation and cylinder action, a great advance would have been made. The author likewise pointed out the economic error involved in the false idea that a superheater was only a cheap accessory to a boiler. This low-price idea was at the bottom of the trouble with superheaters. A superheater should be made of material of the highest possible quality put together on best boiler-making lines. The area of steam way should be from 25 to 50 per cent. greater than the steam pipe area. With cheap superheaters the steam way was reduced in order to give a high steam velocity to prevent the pipes from burning, and this reduced the pressure as much as 15 lbs. (The chairman, Mr. R. D. Munro, said he had found even 25 lbs. pressure reduction in a small pipe superheater.)

The author discussed the limits of temperature to which any superheater could safely be subjected, and pointed out the inefficiency of any superheater placed within a water-tube boiler, which, however, could do excellent work in combination with a separately-fired superheater and feed-water reheater. The furnaces in separately fired superheaters, however, produced a fire temperature of about 2,500° at least, and it was not safe to turn more than 1,200° or 1,300° upon the superheater pipes, so that it was usual with common types to drown the temperature by admitting an enormous excess of cold air between the fire and the superheater, and in this way the economy of superheating was seriously reduced. In the Cruse controllable self-fired superheater, the sting of the temperature was taken up by feed-water reheating drums before the hot gases were



Flue-fired Controllable Superheater—16 Pipes. (Cruse's Patents.)

allowed to touch the superheater pipes, and the fullest possible use was made of the calorific capacity of the fuel. The control system consisted (1) of the stream of feed water entering the drums from the economiser, passing through the internal system of 2-in. copper pipes inside the superheating pipes, and returning to the drum system at the top; (2) direct circulation from the top storage drums



Separately-fired Controllable Superheater and Feed-water Reheater. (Cruse's Patents.)

at the end of the chain to the bottom receiver drums governed by an inspirator fed by superheated steam; (3) direct feed from the economisers, hotwell or cold main into the water collector at the foot of the superheater. These three methods can all be operated separately and in combination, and in parallel with the usual methods of coal and draught regulation.

In the flue-fired type the control is effected, first, by circulating water from the boiler back again to the boiler by means of the inspirator actuated by superheated steam, a constant stream being thus maintained through the internal pipes. This water system is connected at both ends to the water space of the boiler below low water level. It possesses a slow circulation of itself at all times. The superheated steam inspirator enables this velocity to be as many times multiplied as may be necessary for control. Second, by direct feed from the economiser or hotwell, admitted, wholly or in part, through the control pipe system. These two controls are

capable of independent regulation, and may be adjusted and fixed for a given maximum temperature of superheat. Once fixed, they automatically control the superheat by varying the flow of water in accordance with the demand for steam and the flue gas temperature, this control being within narrow limits of variation.

The internal copper pipes full of flowing water have a very powerful controlling effect. Radiation from a hot surface proceeds normally from the surface. Consequently, hot pipe surfaces have an internal radiation to the opposite side of the pipes along diametral lines. Obviously, therefore, a copper pipe in the centre of a larger pipe is exposed to this radiation, and absorbs the excess of heat which travels through the diathermanous steam in the annular space, and this prevents the outer pipes from becoming overheated. The author showed a number of slides to illustrate the two types of superheater, flue fired and separately fired. An interesting discussion ensued, numerous questions being asked and answered.

The illustration of the flue-fired superheater given herewith is from one of twelve at the power station of the Newcastle Corporation Tramways. The illustration of the independently-fired superheater is from one of the No. 2 size apparatus, having a capacity of superheat of 30,000 to 40,000 lbs. of steam per hour, and an equal weight of feed-water reheated, with a storage capacity of 35,000 lbs. of heated water.

PHYSICAL SOCIETY.

Meeting held November 27th, 1903.

Dr. R. T. Glazebrook, F.R.S., President, in the chair.

Mr. Horace Darwin exhibited an electric thermostat. The vessel, the temperature of which is to be maintained constant, is surrounded by oil contained in a bath. In the oil are placed two heating-coils, through which electric currents pass. By automatically controlling these currents, the temperature of the oil, and consequently of the inner vessel, is kept very nearly constant. The control is effected by means of a Wheatone bridge in the outer oil bath. This bridge has two opposite arms of copper and two of manganin, so that it is only balanced at some definite temperature. Its deviations from balance affect the position of a long horizontal boom attached to the suspended coil of a galvanometer. The position of the boom determines the greater or less descent of a "hit or miss" arm which is periodically raised by a rotating cam, and can only fall to its lowest position when the galvanometer-boom is to one side and allows it to pass; this position of the boom corresponds to a fall of temperature of the controlling bridge. Thus the position of the "hit or miss" arm at its lowest position depends on the temperature, and it is the variation of this position which regulates the amount of current passing through the heating coils. When the "hit or miss" arm is at its highest position the galvanometer-boom is absolutely free to move to its position of equilibrium. At every rotation of the cam the "hit or miss" arm is lowered, and if it passes the galvanometer-boom a key is closed and a current passes through the "intermittent" heating coil. The current passing through the "permanent" heating coil is also automatically regulated; if there is not enough heat passing into the oil this current is gradually increased.

Mr. A. P. Trotter said that it was possible to keep a temperature constant within $\frac{1}{100}$° C., but it was very difficult to determine the temperature to that degree of accuracy. In high-class resistance measurements with a Carey-Foster bridge one of the greatest difficulties was with regard to the temperature, which must not only be constant but also capable of exact determination. In the constant-temperature room at the Board of Trade Standardising Laboratory the temperature varied by less than $\frac{1}{5}$° C. from day to day, and he would like to know the greatest accuracy obtainable with ordinary devices in such a room before considering the introduction of the complicated instrument shown to the meeting.

The Chairman said he had recently been trying to solve a somewhat similar problem by making use of a horizontal boom, attached to the suspended coil of a galvanometer, for making and breaking a circuit. His object was to regulate a current of the order of 50 amperes.

The Author said that a thermostat supplied to the Cape Observatory was capable of keeping the temperature within $\frac{1}{100}$° C. for a period of eight hours.

A paper "On the Occurrence of Cavitation in Lubrication" was read by Mr. S. Skinner. The experiments described in the paper arose from an observation made when determining the refractive index of a liquid by means of Newton's rings. When a liquid is run into the space between the lenses, if the upper lens be rolled on the lower, the observer sees following the central dark spot a crescent-shaped space. This is a vacuous or vapour-filled space, for when the motion of rolling ceases the liquid flows into the space and completely fills it. The inflow of the liquid depends in some way on the viscosity, and the effects are more pronounced when a more viscous liquid is used. In ball bearings completely immersed in oil, the experiments show that there must be a small cavity near the point of nearest approach of each ball to its neighbours, and also to the surface on which it is running. As the friction of the bearing is the viscous friction of the oil, it follows that the friction must be considerably reduced by the formation of these cavities, which are filled with relatively non-viscous vapour.

Mr. W. A. Price asked to what extent cavitation was going on in an ordinary round bearing or in the slide valve of a locomotive, and suggested that the views of engineers upon the subject of lubrication might require considerable modification in the light of the present paper.

Mr. C. V. Boys said that, in the author's experiments, cavitation was produced by the approach of two surfaces on one side of their line of contact and their recession on the other side. He thought that, in the case of any cylindrical bearing, the rate of approach and recession would never be great enough to produce cavitation. The case of ball bearings, when using a thick lubricant, was different, and cavitation might occur. If it did, it would occur behind the point of contact, and although the production of cavitation involved a loss of energy, he questioned whether it did any appreciable harm.

Mr. R. Appleyard said that if cavitation occurred in a cylindrical bearing, the cavity would form between the two surfaces which were next coming into contact. If the surfaces were smooth, little harm would ensue; but if they were rough, the occurrence of cavitation would be detrimental, for it would result in direct contact.

Prof. R. Threlfall then exhibited and described the following instruments which he has used in the testing of electric generators by air calorimetry:—(1) A "hot-wire voltmeter," accurate to $\frac{1}{100}$ volt. The wire in this instrument is very fine, and special precautions are taken to keep the tension on it constant, so that the elongation measured is due only to the expansion of the wire caused by the heating effect of the current. (2) A "Pitot tube" for the measurement of air velocity, the velocity being proportional to the square root of the pressure produced in the tube. (3) A "Manometer" for determining pressure differences in Pitot tubes with accuracy. The instrument is reliable to 0·01 mm. of water-pressure. (4) A multiplying pressure gauge in which the motion of a float or ball is used to operate a finger moving round a dial. The dial is divided in such a manner that the square roots of the pressure differences are read off. Air velocities are therefore given directly.

Mr. Duddell, referring to the voltmeter exhibited, asked if there was any trouble with regard to the temperature variation of the resistance of the wire. In using the instrument with large alternating currents it was necessary to use a standard shunt, and difficulties then arose, because of the fact that the self-induction of a shunt, formed of straight bars and capable of carrying the necessary current, was comparable with its resistance. It might be possible to get a satisfactory shunt by doubling the bars upon themselves to reduce the self-induction.

Prof. Threlfall said that there was no difficulty with regard to changes in temperature of the room, because they only altered the zero of the instrument. He had calculated the self-induction of the bars forming his shunts, and had come to the conclusion that it was negligible. Experimentally, he had found that it could not produce an error of 1 per cent. It might be possible to so design a shunt that the mutual induction of its parts would balance the self-induction to a certain extent.

NOTES ON ENGINE DRIVING IN ELECTRIC LIGHT STATIONS.

By F. T. CALLIS.

(*Concluded from page* 971.)

Synchronising and Running.

In continuous-current stations, when a plant is to be put on load, all that has to be done by the driver is to run the engine up to speed; the machine switch is then closed, and the engine governor adjusted to take up the load.

But when, as in an alternating-current station, the plant has to be first brought into synchronism, the speed having to be so adjusted that the field magnets are moving past the armature coils, or *vice versâ*, at exactly the same speed as in the machines already on load, the matter is not then so simple, and requires considerable practice before a man can bring up a machine smartly.

Every driver, under these conditions, should be made acquainted with the phenomenon of "phantom poles," as it is of great service to him if the engine he is bringing up is so situated that he cannot see the pilot lamp on the switchboard.

If the light from an arc lamp, fed from the alternators on load, falls on the revolving poles or coils, instead of them appearing just a blurred mass as they would in the daylight, clearly defined images of these appear, exact in size, shape and number.

If the machine happens to be running exactly in synchronism these images appear stationary, although the actual parts may be making many hundreds of revolutions per minute.

Further, if the speed is slightly below synchronism the images will be seen slowly moving backwards in the

reverse direction to that of the wheel, whilst if the speed is correspondingly fast, they move forward in the direction of rotation.

Now, as to the manner in which a plant should be brought into synchronism; the whole secret lies in realising the fact that the speed of a fly-wheel weighing, perhaps, 35 or 40 tons, cannot be changed as quickly as the quantity of steam passing into the engine to drive the wheel.

The majority of men in handling engines, fail to realise that if they open the stop-valve a little more, the engine does not increase its speed instantly.

When it is seen, either by the pilot lamp beginning to show long periods of brightness, or by the phantom poles only slowly moving backwards, that the engine is nearly in synchronism, then leave the valve alone, and the engine will slowly come up to its correct speed, at any rate, near enough to admit of the machine switch being closed with safety. Just sufficient steam is required to drive the engine at synchronous speed, but if a man keeps opening his valve until that speed is reached, the engine will run right past, and then have to be brought down again.

Further, steam should never be given to the engine in puffs, by opening the valve and quickly closing it, in order to effect a slight increase of speed, as this may result in the correct speed being attained momentarily, but just as the machine switch is closed it falls again, causing possibly a serious electrical disturbance between the machines.

What is wanted is that a man should handle an engine not only with his hands, but also with his head!

If a machine is coupled on to the switchboard, but is only lightly loaded, and the engine should show a tendency to "hunt," this can often be checked by throttling the steam at the stop valve, until the load rises.

On load the piston rods should receive a good deal of the driver's attention, and should be well swabbed every 20 minutes or half an hour.

A hot rod, especially if fitted with metallic packing, is liable to do a great deal of damage, the packing sometimes being melted out and running up the whole lot solid with the rod.

There is also a danger of bending the rod, as, if the heating takes place on one side only, this side never, upon cooling, contracts to the original length but remains a fraction longer, often sufficient to make the rod afterwards a constant source of anxiety. This same effect of distortion occurs when crosshead and crankpin brasses become badly heated, the sides of the brasses invariably closing in on the pin, so intensifying the trouble and sometimes irretrievably damaging the pin if solid brasses are used.

One of the great advantages of white metal bearing surfaces lies in the fact that when heated the metal may even be melted out, but the pins do not suffer. Another evil resulting from brasses being run hot, whether the bearing surface is brass or white metal, is that the hard polished skin formed by continual running is broken, and no really cool working of that particular part will be obtained until another such skin has had time to form.

If any of the piston rod or valve spindle glands in open type engines are leaking, every care should be taken to prevent the water dropping into the oil cups on the engine motion, as through this the oil is washed out and never reaches the pins. The writer has known of many hot top and bottom ends, caused through nothing else but leaky glands.

It will be found that enclosed engines, as a rule, work at a very high temperature, in spite of the presence of distance pieces, the oil in the tanks sometimes being 130° or 140° F. after a few hours' run, with an engine room temperature of about 80° F. Having reached this point, however, there will be no further appreciable rise, and experience will soon indicate the normal running conditions.

Condensers.

The enormous saving in water and coal effected by condensers makes their use almost imperative in a large central station, and this saving is further increased where arrangements are made for the condensed steam to be pumped back into the boilers.

Of the many types of condensers extant, the most generally-used form is either the "surface" or "jet" condenser, the conditions of the available water supply determining to a great extent which is installed.

As mentioned previously, the great danger connected with a jet condenser is the risk of the water backing up into the engine cylinder from the jet dome, if the pumps fail.

This is guarded against as far as possible by inserting a non-return valve in the exhaust pipe near the condenser, and this valve should be closed and opened every day to ensure reliable working.

In jet condensers of the Worthington type trouble is frequently experienced through the pumps working in a jerky, uneven manner, caused by starting the pumps too quickly before opening the water supply valve, the pumps becoming charged with air which cannot get away. The pet cocks will show which end of the pump is affected, and then, by opening the by-pass valve, which allows water to pass from the discharge side back to the pump barrel, the air is displaced. If this does not answer, slow the pumps down as much as possible without risking losing the vacuum, and open the water valve wide. This floods the condenser, and very effectually removes all the air, after which, when it is seen the pumps are making their full stroke, they can be increased in speed, and the water valve adjusted.

Where the water supply is limited and has to be used over and over again, metal valves have to be substituted for rubber in the condensers, as the high temperature resulting very soon ruins the valves, and the maintenance of even a moderate vacuum becomes almost impossible.

With metal valves the limiting temperature is reached only when the injection water is already so hot as to be unable to take up the heat contained in the exhaust steam.

With surface condensers the loss of the vacuum is a more serious and troublesome occurrence than with a jet condenser if caused by failure of the water supply.

The hot tubes quickly evaporate the circulating water which may remain in them, and pressure is formed which prevents the pump again getting hold of the water, the head and bucket valves being kept closed; moreover, there is considerable risk from the existence of any pressure, however slight, of bursting the ends out of the chamber. Under these circumstances, the only thing is to open the snifter valve on the pump to allow the steam and water vapour to escape, and let the condenser cool down. On starting again, keep the snifter valve closed until it is seen that the pump is drawing water freely, when it must again be opened, as, if left shut, more water may be forced into the condenser than the discharge can carry away, resulting in heavy vibration and possible fracture of the pipes.

ANNUAL DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

The fifteenth annual dinner of the Institution was held on Wednesday evening last week in the Grand Hall of the Hotel Cecil, the President, Mr. Robert Kaye Gray, occupying the chair. The occasion was a record one, the hall being completely filled, and the proceedings passed off with the greatest success. There were about 500 present, and the guests included Mrs. Hertha Ayrton, Lord Claud Hamilton, Lord Monkswell, Lord Reay, Lord Biddulph, Sir W. H. White, Sir Norman Lockyer, Sir W. Ramsay, Sir A. R. Binnie, Sir J. Wolfe Barry, Sir W. de W. Abney, Sir Guilford Molesworth, Sir C. J. Owens, Sir J. F. Bridge, Major-Gen. W. T. Shone, Col. J. J. Mellor, Col. G. Henderson, Col. R. M. Ruck, Col. W. Pitt, Lieut.-Col. H. A. Yorke, Capt. W. Barker, M. E. Hospitalier, the Hon. A. Brodrick, Dr. J. H. T. Tudsbery, Dr. W. A. Tilden, Dr. J. Larmor, Dr. B. A. Whitelegge, Messrs. J. Ardron, E. Worthington, Leslie Robertson, J. G. Colmer, D. Howard, L. A. Atherley-Jones, J. Y. Buchanan, J. P. Barker, A. Carpmael, K. B. Murray, W. Weaver, R. W. Wallace, A. C. Ellis, O. R. Bury, J. F. S. Gooday, F. W. Pixley, W. E. Soar, J. C. Inglis, and other distinguished gentlemen, besides the majority of the Members of Council, chairmen of local sections, and other members of the Institution.

The menu left nothing to be desired, and an excellent programme of music was performed by the Imperial Orchestra.

After the President, in brief and appropriate terms, had

proposed the loyal toasts, which were duly honoured, the Right Hon. Lord Monkswell, chairman of the L.C.C., proposed "The Institution of Electrical Engineers," coupled with the name of the President, Mr. R. K. Gray. Lord Monkswell regarded electrical engineers as the spoilt children of science, and referred to the immense importance of electrical energy nowadays. In his reply, the President announced the receipt of a telegram conveying the greetings of the Italian Electro-Technical Association to the company, and expressed the pleasure felt by the Council in welcoming the presence of numerous authorities on the subject of education, and representatives of important railway companies. After referring in terms of warm approval to the manner in which the L.C.C. was converting the tramways to electrical working, the President remarked that the same commendation could not be applied to some of the smaller undertakings of the Council. The attempt on the part of the large Government departments and municipal authorities to become "universal providers" tended to retard progress, and to check the spirit of invention. The high-speed engine, the Parsons turbine and other improvements due to independent thought, were developed to meet the needs of the electrical engineer, who had not suffered from too much standardisation. Care must be taken that educational methods also were not subjected to excessive standardisation.

Mr. J. Swinburne then proposed the toast of "Railways and Telegraphs." Remarking on the great importance of the former to the national welfare, he suggested that the right thing was for every railway to immediately electrify itself; but unfortunately it seemed to be the settled policy of Parliament to put every possible obstacle in the way of enterprising companies, apparently with the object of abolishing profits, because they came out of the pocket of the public. The telephone might yet be the most important rival of the railways; the more facilities were provided in towns for ingress and egress, the more people used them, so that the traffic problem seemed to be insoluble, but when people did all their business by means of the telephone the difficulty would be avoided.

Sir C. J. Owens, general manager of the L. & S.W. Railway, in reply, referred to the intimate connection between railways and telegraphs, and believed that the time was approaching when electricity would be the sole motive power on railways. The new agent would step into no mean inheritance; the railways of this country annually disbursed no less than 20 millions sterling in wages alone.

Sir J. Wolfe Barry, chairman of the Eastern Telegraph Co., stated that more than half of the 225,000 miles of submarine cable in the world were in British hands, representing a capital of 30 millions sterling, and the number of words transmitted between Great Britain and foreign countries was 100 millions per annum. A reduction of 60 or 70 per cent. in the rates had been effected in the course of a few years. Referring to wireless telegraphy, in which he took the keenest interest, Sir John Wolfe Barry pointed out that the Eastern Co. had five cables landing in Cornwall, over which, at busy hours, 15,000 words per hour were received. Forty cables touched England, and if they were all worked at the same rate, 120,000 words per hour, or, say, 12,000 letters per minute, were dealt with. Let them fancy this discharge being bombarded into the ether and being met with an equal bombardment from abroad! The prospect was appalling! The subject involved immense difficulties, which were not thoroughly grasped by many people. It was difficult to measure the services which had been rendered to this country, in the short period since 1850, and to the world, by the cables, in promoting peace and goodwill—mainly through British enterprise.

Prof. Silvanus P. Thompson briefly proposed the toast of "Our Guests," pointing out the great variety of the departments, societies, educational authorities, &c., which were represented there. He referred especially to the presence of M. E. Hospitalier, and to the *entente cordiale* which subsisted between France and this country. Prof. Thompson coupled with the toast the names of Lord Claud Hamilton, Sir William White (President Inst.C.E.), and M. Edouard Hospitalier, President of the Société Internationale des Electriciens. The toast was honoured with enthusiasm.

Lord Claud Hamilton said that electricity was going ahead too fast for ordinary men; the chairmen of railway companies must handle their shareholders' capital with prudence, and hardly dared embark on the conversion of their systems to electrical working for fear lest the system adopted might be superseded before it was completed. They were keeping a keen watch on electrical developments, and hoped in the future to be able to adopt electrical working. Sir W. White, in his reply, objected to the distinction drawn between "scientific" and "engineering" societies; pure and applied science were of equal importance. It was the duty of engineers to regulate the training of engineers, and they must not allow pure scientists to dictate to them the manner of its conduct. He referred feelingly to the death of Mr. Herbert Spencer, who was, by his early training, a civil engineer.

M. Hospitalier, on rising to reply, was accorded an ovation. Speaking rapidly in French, he expressed his pride in having been for 22 years a member of the Institution.

The company then adjourned to the Victoria Hall, where a programme of music was performed. The music, however, was quite inaudible in the buzz of conversation, which was kept up almost until midnight. Undoubtedly the occasion touched the high-water mark of success and enjoyment.

ON SOME FICTITIOUS FIGURES SUPPLIED BY MUNICIPAL ENGINEERS.

By E. KILBURN SCOTT, M.I.E.E., A.M.I.C.E.

The well-deserved wigging given at the recent Parliamentary inquiry to those who are responsible for making up municipal accounts will, no doubt, by its moral weight, lead to more correct balance-sheets being presented. It is to be hoped also that, in stating any financial details of their undertakings, municipal engineers will take the lesson to heart, and quote figures which are at least *somewhere* near the mark. Take, for example, the "Report on Permanent Way Construction and Maintenance," compiled by Mr. John Young for the Municipal Tramways Association of Great Britain. Amongst other matters connected with the track work, Mr. Young asked the straightforward question, "What has been your average cost of permanent way, excluding bonding, but including all special work, per mile of single track."

Now, taking at random four municipalities which have carried out the work with their own staff, and whose data are compiled alongside, in the Tables we get, on page 18 :—

	Per mile single track.
Newcastle-on-Tyne	£8,500
Oldham	£8,400
Manchester	£4,100
Rochdale	£6,200

Again, on pages 17 and 20, we find—

Hull	£5,750
Huddersfield	£4,055
Halifax	£4,820
Plymouth	£5,900

On the face of it, these figures for Manchester, Huddersfield and Halifax are much too low, and there appears to be no excuse for such figures being put forward, because the majority of the replies appear to have been sent in correctly.

The fact is, matters appear to be so lax financially in the affairs of some municipalities, that the engineers do not seem to know when they have got inclusive figures.

Lighting, watching, general charges and use of plans required for laying tramlines will cost a contractor at least £300 a mile, and it is probable that on the lavish system on which corporations work the cost is much more. Again, in the case of paving, the methods of corporations are not as others are. Aberdeen, for example, where setts are probably cheaper than anywhere else in the country, gives its cost as £6,000 per mile of single track, whereas Dundee is down at only £4,628, clearly another impossible figure.

To say nothing stronger, it is not courteous to treat Mr. Young's queries in this way, as it throws doubt on the whole of the data, and reduces the value of what is otherwise a most useful report.

The question is, What is to be done about the matter? If a company's engineer sends in bogus figures and they are

found to be wrong, he is carpeted; but who is to give the municipal engineer a talking-to?

Being employed by Councillors who know nothing of the business, and who probably never see a technical journal, the municipal engineer appears to be in an extraordinarily favourable position—for himself. He is apparently unsackable and uncorrectable, and he has only to get married or get another berth elsewhere to have lavish praise and substantial presents showered on him. The municipal engineer is undoubtedly the spoilt child of the profession.

THE ST. MARYLEBONE BOROUGH COUNCIL.

Events which took place last week show that whereas the Metropolitan Electric Supply Co. are determined to assert their legal rights in connection with the sale of part of their undertaking to the St. Marylebone Borough Council, the ratepayers in that district are waking up to the real terrors of the situation. It is not too much to say that they are threatened with a financial loss, which, if it does not reduce them to bankruptcy, will impose an enormous burden upon their district for many years to come.

Let us recapitulate, in as few words as possible, the facts which have led up to the present position. In February of the present year it was decided in arbitration proceedings that the Council must pay to the company the sum of £1,212,000 for that part of their undertaking which supplied the borough of St. Marylebone with electric light, the purchase to date as from December 31st, 1901. In addition to this the Council was ordered to pay the costs of the proceedings, which amounted to some £70,000, and an additional sum of £100,000, this being the capital expended by the company in the district during 1902 and 1903. Of the sum of £1,212,000 above mentioned, £1,000,000 represents the figure at which the arbitrator estimated the goodwill of the company, *i.e.*, the discounted value of the profits during the 30 years from 1901 to 1931, when the company's provisional order expires.

The Borough Council applied to the London County Council for the necessary funds to complete the purchase, but was refused, and the Local Government Board and the Board of Trade have refused to interfere. In these circumstances, no rate having been levied for the purpose of discharging the debt, the company were compelled to apply to the Court of Chancery for a decree of specific performance. An order was granted some time back to the effect that the money should be handed over on December 31st, 1903, with liberty, however, to the Council to apply for an extension of time if necessary. An application for this purpose was made last week to Mr. Justice Buckley. From the report of what took place on the application (which is published in another column of the present issue), our readers will readily understand the present state of affairs. A decree for immediate payment would compel the Council to levy a rate of 20s. in the £! Influenced by the fact that this would be an oppressive burden to the ratepayers, the judge granted a further extension of time upon terms.

In the course of his judgment he said:—"Further capital expenditure on the undertaking is necessary, and by their statutory obligation, and the order of the Court, the company have to go on spending money, and they say it is not reasonable that they should have to raise more capital by going to their bankers, and that they ought not to be out of pocket by spending money on the Council's property. They ask, therefore, that £60,000 in respect of past capital expenditure be repaid to them within a short time. That will require a rate to be made of 9d. in the £, and the payment must be made a term of the order."

In granting the further extension, his Lordship was influenced by the fact that the Council is about to apply to Parliament in the next session for borrowing powers to raise the necessary sum.

We have often commented upon the fatuous policy which has landed the municipality in this extraordinary position. It imagined, no doubt, that the profits of the company should be devoted to "the relief of the rates," little thinking that interest upon the capital expenditure necessary to acquire the profit-earning undertaking would swallow up all the prospective profits and involve a loss as well. Now it has to choose between an appeal to Parliament for leave to sanction the loan; an appeal to Parliament to release it from the contract altogether; or a compromise with the company. Each one of these courses must involve loss to the ratepayers.

In the first place, assume that the loan is granted. The annual profits of the company, upon which the Council may rely in years to come, have been roughly estimated, by a business man, who contributed an article to the *Times* of December 10th, at £55,000. The sum necessary to pay interest at 4 per cent. and provide for the sinking fund is estimated by the same authority at £105,000 per annum. The balance of £50,000 must come out of the rates. Thus, for the privilege of having municipal electric light, the inhabitants of St. Marylebone will have 9d. or 10d. added to their rates! Is it conceivable that Parliament, in its wisdom, will pass an Act which will place a liability of this kind upon a district which includes amongst its ratepayers a large number of persons to whom the present rates are a heavy burden?

If, as may perhaps be the case, the Legislature refuse to sanction the loan, it cannot in justice to the company annul the contract without providing for compensation to the vendors. The sale of their undertaking was not of the company's seeking; it was decreed by an Act passed at the instance of the Council, and Parliament (although all-powerful) cannot now deprive the company of their victory in the arbitration proceedings.

If the loan is refused, and unless the contract is annulled by Parliament, it would seem that the Council is at the mercy of the company. A local authority may be ordered by the Court to make a rate for the purpose of satisfying a judgment within six months after the judgment is obtained (R. *v.* Rotherham Local Board, 8 E. & B., 906). Again, the Crown Office rules provide that any judgment or order against a corporation wilfully disobeyed may, by leave of the Court or a Judge, be enforced by sequestration against the corporate property, or by attachment against the directors or other officers thereof, or by writ of sequestration against their property. Should this state of things prevail, the ratepayers will be no better off than if they had to pay rates commensurate with payment of the full amount of the purchase price to the company.

Lastly, compromise with the company at this eleventh hour can hardly be carried out without some considerable sacrifice on the part of the ratepayers. The company's business has been disorganised, law costs have been incurred, and already a payment of £60,000 on capital account has been ordered. All these losses must be made good before the company can be expected to come to terms.

Yet "Compromise!" is the cry of the ratepayers. An influential deputation appeared before the Council last week, and prayed for compromise; but the Council, as if determined to carry on the present extravagant policy as far as possible, immediately passed a resolution by 41 votes to 17 in favour of seeking Parliamentary powers for the grant of a loan.

Whatever the end of this unprecedented chapter in the history of municipal trading, it has had the good effect of turning public attention to municipal extravagance. Although we sympathise with the unfortunate victims, we cannot help feeling gratified by this proof positive that it is not always advantageous for a municipality to attempt to take over the responsibilities of electric lighting.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

26,074. "Improvements in sound-conveying apparatus, applicable to speaking tubes, telephones and phonographs." I. B. Hogan. November 30th.

26,082. "Means for automatically preventing the speed of electric cars from exceeding any predetermined limit." E. F. Kent and F. Rogers. November 30th.

26,083. "Improvements in electric furnaces." W. Cardno and J. G. Dalton. November 30th.

26,112. "Improvements in induction motors." K. A. Lindstrom. November 30th.

26,124. "Improvements in apparatus for controlling and operating the points of electric railways and tramways." T. B. Stewart, W. H. Turner and R. E. Dixon. November 30th.

26,144. "Electro-magnetically operated apparatus for controlling the inlet devices of steam and gas turbines." T. Reuter. November 30th (Complete.)

26,165. "Improvements in electrical elevators." R. C. Smith. November 30th.

26,170. "Improvements in or relating to electric switches, or controllers, and magnetic blow-outs employed therewith." P. Kirkup and W. Alderson. November 30th.

26,174. "Improvements in couplings for electric cables." F. W. Howorth. (F. Everhart and J. Dossert, United States.) November 30th. (Complete.)

26,180. "Improvements in electric fuses." A. Hepke and H. Ascher. November 30th.

26,200. "Improved electric generator." D. Burns and J. M. Fleming. December 1st.

26,208. "J. E. Jaggar's cover for electric tramcars and others." J. E. Jaggar. December 1st.

26,211. "Multiplex telephony." W. Fairweather. (W. M. Miner, United States.) December 1st.

26,230. "Improvements in or relating to combined trolley arm and brake controllers for electric tramcars." International Trolley Controller Co., and J. Kynoch. December 1st. (Complete.)

26,241. "Improvements in electrodes for secondary batteries." H. Leitner. December 1st.

26,242. "Improvements relating to telphers, partly applicable also to vehicles propelled electrically from a distance." Siemens Bros. & Co., Ltd. (The United Telpherage Co., United States.) December 1st. (Complete.)

26,248. "Improvements in telephone transmitters." P. G. Randall. December 1st. (Complete.)

26,255. "Improvements in attachment to desk telephone instruments." H. P. Childress and N. M. Sauls. December 1st. (Complete.)

26,259 "Improvements in apparatus or means for regulating or governing the speed of engines employed in driving electric current generators." J. Y. Johnson. (The Elektricitäts Aktien-Gesellschaft vormals W. Lahmeyer & Co., Germany). December 1st. (Complete.)

26,267. "Improvements in and relating to electric measuring and recording devices." C. W. Atkinson. December 1st.

26,268. "Improvements in and relating to electrolytic meters." C. W. Atkinson. December 1st.

26,269. "Improvements in or relating to switches for electric current." W. P. Thompson. (H. Schor, France.) December 1st.

26,273. "Improvements in controlling devices for electric motors." G. A. E. Kohler. December 1st. (Complete.)

26,274. "Improvements in means for ventilating electrical machines." The Aktien Gesellschaft Brown, Boveri & Cie. December 1st. (Date applied for under Patents Act, 1901, December 16th, 1902, being date of application in Switzerland.) (Complete.)

26,276. "Improvements in or relating to electricity meters." W. Geipel and F. M. T. Lange. December 1st.

26,291. "Safe and improved method of attaching detonators, caps or exploders to fuse tape or electric wires, making the same water and air-tight." W. H. Edwards. December 1st.

26,307. "An improved electrical connection for electro-chemical apparatus." F. J. Turquand and J. F. Wakelin. December 2nd.

26,378. "Improvements in and means for effecting the regulation of asynchronous alternating or three-phase current electric motors." J. Y. Johnson. (The Elektricitäts Aktien Gesellschaft vormals W. Lahmeyer & Co., Germany.) December 2nd. (Complete.)

26,380. "Improvements in safety fuses for electric circuits." J. Y. Johnson. (The Elektricitäts Aktien Gesellschaft vormals W. Laymeyer & Co., Germany.) December 2nd. (Complete.)

26,427. "Improvements in electro-magnetic controlling gear for electric arc lamps, electric circuit-breakers, and the like automatic mechanism." A. Eckstein and A. E. Angold. December 3rd.

26,435. "Improvements relating to electrically-actuated mechanism." L. Jacot. December 3rd.

26,449. "A new form of ammeter and voltmeter." W. J. Bell. December 3rd

26,456. "Improvements in insulated electric conductors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,457. "Improvements in insulated coils for electrical apparatus and process of making the same." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,458. "Improvements in insulating electric conductors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,460. "Improvements in electric rheostats." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,461. "Improvements relating to rotary electric converters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,462. "Improvements in electric arc lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,464. "Improvements in static influence electrical machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,465. "Improvements in systems of electric motor control." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) December 3rd.

26,476. "Improvements in or relating to electric incandescent lamps." P. J. H. Driscoll and H. Sleeman. December 3rd.

26,488. "Improvements in and relating to electrical ignition apparatus." M. S. Napier. December 3rd.

26,513. "An improved canopy trolley for electric tramcars driven on the overhead system." J. A. de Macedo. December 4th.

26,530. "Improvements in or relating to mechanism for electro-mechanically playing pianos, organs, and the like." H. E. Fugill. December 4th.

26,533. "Electric heaters and improvements relating thereto." W. Krause. December 4th.

26,537. "An improved conduit for containing electric cables and wires and pipes and tubes and the like." W. Hepworth-Collins. December 4th.

26,538. "An improved conduit for containing electric cables and wires and other wires, tubes, and the like primarily intended to be carried along thoroughfares." W. Hepworth-Collins. December 4th.

26,553. "Improvements in or connected with apparatus for electrically igniting miners' safety lamp." W. Best, A. Best and R. O. Best. December 4th.

26,577. "Improvements relating to field magnets for electrical machines." G. Finzi. December 4th.

26,580. "Improvements in incandescent electric lamps." A. Bourdos and H. C. W. Gibson. December 4th.

26,603. "Improvement on electric motors and dynamos." H. Faerber. December 5th.

26,607. "A new combined electric switch, wall socket and plug." H. Robertson. December 5th.

26,618. "A mechanical switch for electric installation of motor cycles." R. C. Meredith. December 5th.

26,659. "Improvements in magneto-electric ignition devices for internal combustion engines." P. Masson. December 5th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

Overhead Equipment of Electric Tramways and Care Therefor. J. T. Pearson. 5,725. March 12th.

Electric Insulating Material. P. Staedtefeld. 5,892. March 13th.

Sparking Plugs. W. P. Thompson. (A. Vogel and R. Egg, Switzerland. 5,893. March 13th.

Conductors and Collectors for Electric Railways and Tramways. D. Kempt. 5,938. March 14th.

Brackets for Attaching Electrical Devices to Desks. A. R. Ferguson. 6,063. March 16th.

Safety Fuses. H. M. Salmony. 6,110. March 16th.

Telephone Receivers and Transmitters. J. G. Halstrom. 6,605 March 21st.

Electrically Operated Railway Switches and Signals. A. Needlemann. 6,546. March 20th.

Terminals for Secondary or Electrical Storage Batteries. E. A. Tunbridge. 7,337. March 30th.

Controllers for Electric Motors H. R. Stuart. (Date applied for under Patents Act, 1901, April 2nd, 1903, being date of application in United States.) 7,481. March 31st.

Current Controllers. L. Bradley and S. Allen. 7,561. April 1st.

Electric Receiver Clocks. J. W. H. Uytenbogaart. 7,701. April 2nd.

Monophase and Polyphase Alternating Current Machines. W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) 7,714. April 2nd.

Electric Motors. A. Kimble and F. S. Betz. 8,472. April 14th.

Magneto-electric Generators. B. P. Remy and F. I. Remy. 8,488. April 14th.

Telephone Transmitters. E. B. Fahnestock. 8,600. April 15th.

For Electroplating. P. Hubert. 8,679. April 16th.

Electrical Burglar Alarm. J. Weatherby. 8,690. April 16th.

Electrolytic Preparation of Permanganate of Alkaline Earth Metals and other Heavy Metals. G. W. Johnson. 8,833. April 18th.

Controlling Electric Circuits. G. A. Tate and F. E. Newbery. 9,586. April 28th.

Treating Materials by Radiated or Reflected Heat in Electric Furnaces. F. W. Howorth. (Trollhattans Elektriska Kraftakiebolag, Sweden.) 9,932. May 1st.

Battery Plates. J. Bijur. 10,541. May 8th.

Improvements in Switches for Electric Circuits. C. E. Hunter and J Purvis. 10,621. May 9th.

Electric Dynamos and Motors. N. H. Edgerton. 10,788. May 12th.

Brush Holders for Dynamo-electric Machines and Electric Motors. The Johnson-Lundell Electric Traction Co., Ltd. (R. Lundell, United States.) 11,125. May 15th.

Telephone Switch Bonds H. H. Lake. (Communicated.) 11,738. May 22nd.

Improvements in and Relating to Field Magnets and like Electric Apparatus. 11,840. O. T. Blathy.

Brake Gear for Electrical Hoisting Apparatus. W. H. Scott. 11,844. May 23rd.

Coin-controlled Locks for Telephone Receivers. P. M. Justice. (The Controller Co. of America, United States.) 12,015. May 26th.

Electrolytic Apparatus such as Secondary Batteries. J. Y. Johnson. (H. B. Ford. United States.) 12,032. May 26th.

Pocket Lanterns. C. Gloerfeld. 12 078. May 27th.

Production of Electrolytic Deposits. E. Maller. 21,294. May 28th.

Transforming Electric Waves, Applicable to Wireless Telegraphy. F. Poraun. 12,484. June 2nd.

Electro-magnetic Machine for the Ignition of the Mixture in Explosion Motors. G. F. Pichard. 12,516. June 2nd.

Electric Meters. Compagnie Anonyme Continentale pour la Fabrication des Compteurs a Gas et Autres Appariels. 12,801. June 6th.

Electric Burglar Alarms. C. O. Miller. 12,865. June 8th.

Fuse Head for Electric Blasting. F. Render. 13,061. June 11th.

Mercury Current Interrupters. R. Otto. 13,098. June 11th.

Clutch for Electric Motors. C. Wust-Kunz. 13,284. June 13th.

Electric Magnetic Chuck for Machine Tools. M. Margowski and C. Gorick. 13,373 June 15th.

Electro-magnets for Magnetic Ore Extractors. H. J. Haddan. 13,570. June 17th.

Electrically operated Ventilating Fans. H. J. Haddan. (The Bergmann Electricitäts Werke Aktiengesell-chaft, Germany.) 14,106. June 24th.

Covers for the Protection of Electrical Apparatus. C. M. Dorman and R. A. Smith. 14,286. June 27th.

Ship's Telegraph Alarum. P. Manson. 14,523. June 30th.

Oil Switches. H. P. Ball. 14,560. June 30th.

Automatic Circuit Breakers. H. P. Ball. 14,561. June 30th.

Circuit Breakers. H. P. Ball. 14,562. June 30th.

Magneto-electric Igniting Apparatus for Internal Combustion Engines. W. Roos. 15,337. July 10th.

Magneto-electric Igniting Apparatus for Internal Combustion Engines. W. Roos. 15,338. July 10th.

Vehicle for Conveying Electric Cable Drums and Other Cylindrical Bodies. W. E. Jones, W. R. Jones and W. G. H. Sedwell. 15,929. July 18th.

Electro-magnetic Brake for Electrically-propelled Cars. H. Seggel. 15,992. July 20th.

Circuit-controlling Devices, Chiefly Designed for Use with Electric Flash Signs. H. H. Lake. (Automatic Time Switch Co., United States.) 16,100. July 21st.

Electrical Signalling Systems for Railways. C. W. Mills. 16,138. July 21st.

Signalling Apparatus Worked by Alternating Currents. Siemens Bros. and Co. (Communicated.) 16,450. July 25th.

Actuating Valves, Cocks, Electric Switches, &c., at Predetermined Times. H. L. P. Boot. 16,698. July 30th.

Holding Devices for the Collecting Brushes of Electrical Machines. G. Breger. (Electricitats Gesellschaft Alioth, Switzerland.) 16,808. July 31st.

Printing Telegraph Instruments. C. M. Stiner. 16,878. August 1st.

Trolleys for Electric Traction. H. H. Lake. (Communicated.) 16,939. August 4th.

Steering Gear for Motor Road Vehicles and the Like. T. Mathewson and A. J. Fielding. 17,057. August 5th.

Electrical Interrupting Devices for Currents, Particularly those of High Intensity. T. J. Murphy. 18,336. August 25th.

Actuating Switches or the Like. W. E. Evans. (Allgemeine Elektricitats-Gesellschaft, Germany.) 18,740. August 31st.

Electrical Controllers. W. Fairweather. (Deihl Manufacturing Co., United States.) 18,907. September 2nd.